JEM®10 *Polyphase Meter*

Instruction
Manual

Publication 15425-001
Revision N
February 2001

AMETEK POWER INSTRUMENTS

Scientific Columbus
255 North Union Street
Rochester, NY 14605
Phone: 888/880-5361
Fax: 716-238-4947

APPROVED

WARRANTY

Seller warrants its Equipment to meet applicable specifications, if any, and to be free from defects in material and workmanship for a period of one (1) year from date of shipment to the original Purchaser. Upon receipt of prompt notice from Purchaser, referencing the order number and detailing the claimed nonconformity or defect, Seller shall, at its option, repair or replace the Equipment. Equipment returned to Seller will only be accepted with a Returned Materials Authorization number ("RMA") issued by Seller or one of its authorized representatives. Inbound shipping charges to Seller's factory in Rochester, NY, or other designated facility are the responsibility of Purchaser. Normal shipping charges for the return to Purchaser of repaired or replacement Equipment shall be the responsibility of the Seller (North American points only).

Repair or replacement of the Equipment in the manner described above is the exclusive warranty remedy and shall constitute complete fulfillment of all Seller's liabilities for breach of this Warranty. Seller assumes no responsibility hereunder for any Equipment damage or failure caused by (a) improper installation, operation, and maintenance of the Equipment, or (b) normal wear and tear on disposable and/or consumable parts. This Warranty shall be void in the event of unauthorized modification or servicing of the Equipment.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTIES OF QUALITY, WHETHER EXPRESSED OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). In no event shall Seller be liable hereunder for any special, indirect, incidental, or consequential damages including but not limited to loss of revenue or production.

PROPRIETARY NOTICE

The information contained in this publication is derived in part from proprietary and patented data of Scientific Columbus. This information has been prepared for the express purpose of assisting operating and maintenance personnel in the efficient use of the JEM® Series meters, and publication of this information does not convey any rights to reproduce it or use if for any purpose other than in connection with the installation, operation, and maintenance of the equipment described herein.

Contents

Contents

Contents iii

1. General Information 1
1.1 Purpose of Manual 1
1.2 JEM10 Meter Overview 1
1.3 Model Number Description 3
1.4 Specifications 4

2. Meter Installation 11
2.1 Physical Dimensions 11
2.2 Wiring Diagrams 14
2.3 Options Connections 23

3. Meter Operation 41
3.1 Meter Faceplate and User Interface 41
3.2 Meter Display Description 43
3.3 Register Initialization 46
3.4 Register Display Modes 47
3.5 Setting the Date, Time, and Presetting Register 48
3.6 Analog Output Option 53
3.7 KYZ Pulse Output Option 53
3.8 Alarm and Status Outputs 53
3.9 Load Profile 54
3.10 Serial Communication 55
3.11 CommRepeater Communications Option 59
3.12 Meter Configuration 63

4. Test & Calibration 65
4.1 Overview 65
4.2 Optical Port/KYZ Meter Test 65

4.3 Testing the JEM10 Meter with the MicroJoule II 66
4.4 Testing with the SC-30™ 67
4.5 JEM10 Calibration 70

5. Maintenance 75
5.1 Meter Assembly 75
5.2 Circuit Board Replacement 75
5.3 Firmware Upgrade 78
5.4 Health Diagnostics 79

6. Theory of Operation 83
6.1 Technical Overview 83
6.2 Hardware Function 86
6.3 Time-of-Use (TOU) Metering 94
6.4 Load Profile 96

Default Configuration 99

Accessories 109

Electrostatic Discharge 111

Serial Commands and Responses 115

Glossary 119

1. General Information

1.1 Purpose of Manual

This manual defines the JEM®10 meter specification and operation. It is meant to provide operating instructions on using the meter. Configuration parameters are discussed in more detail in the JEMSET™ Instruction Manual.

1.2 JEM10 Meter Overview

The JEM10 meter is a solid-state, polyphase, multifunction meter for use in measurement of power-measurement quantities. The JEM10 uses the same analog time-division-multiplication circuit that is used in the time-proven JEM®1 meter. The JEM10 is available in several combinations of kWh, kvarh, kQh, or kV^2h measurements for a variety of installations including socket-base (S-base), A-base, and switchboard case.

The JEM10 generates analog signals from the time-division-mulitplication circuits and integrates them to produce up to five pulse-output signals including: ±watthours, ±varhours or ±Q-hours, and volt-squared hours. These pulse-output signals are then sent to the CPU to be processed into various display registers and load-profile data. The meter can provide the analog and pulse outputs for external connection.

The JEM10 offers a large number of display register types that can be viewed from the meter's display or retrieved using serial communications. Some of the register types include consumption (summation), peak demand, time and date of peak demand, coincident demand, average power factor, coincident power factor, cumulative, continuous cumulative registers, and various status registers including date, time, health status, and firmware version. The JEM10 has time-of-use capabilities. Each register can be associated with a particular time-of-use rate.

The meter has an internal pulse recorder for storing load-profile data. This provides up to 70 days of pulse data storage for the five quantities of data being stored at 15-minute intervals. Special events such as power failures, timesets, and demand resets are also

stored in the load-profile data. This data can be retrieved through serial communications by using Scientific Columbus' JAV™ software or by MV-90™ supplied by UTS.*

Serial communications are performed through an optical port on the front of the meter and a communication option board (RS-232, 20 mA, or the 9600-baud internal modem). The meter has two levels of password protection to accommodate read-only applications. A hardware key is also provided with the meter which, if removed, prevents any configuration or calibration changes.

The JEM10 is software configureable using the JEMSET software. This software allows the meter to be scaled for direct primary readings, demand information, register information, load-profile configuration, and time-of-use rates. Refer to the JEMSET manual for details on all the different parameters that can be programmed into the JEM10.

*MV-90 is a trademark of Utility Translation Systems, Inc., (919) 876-2600.

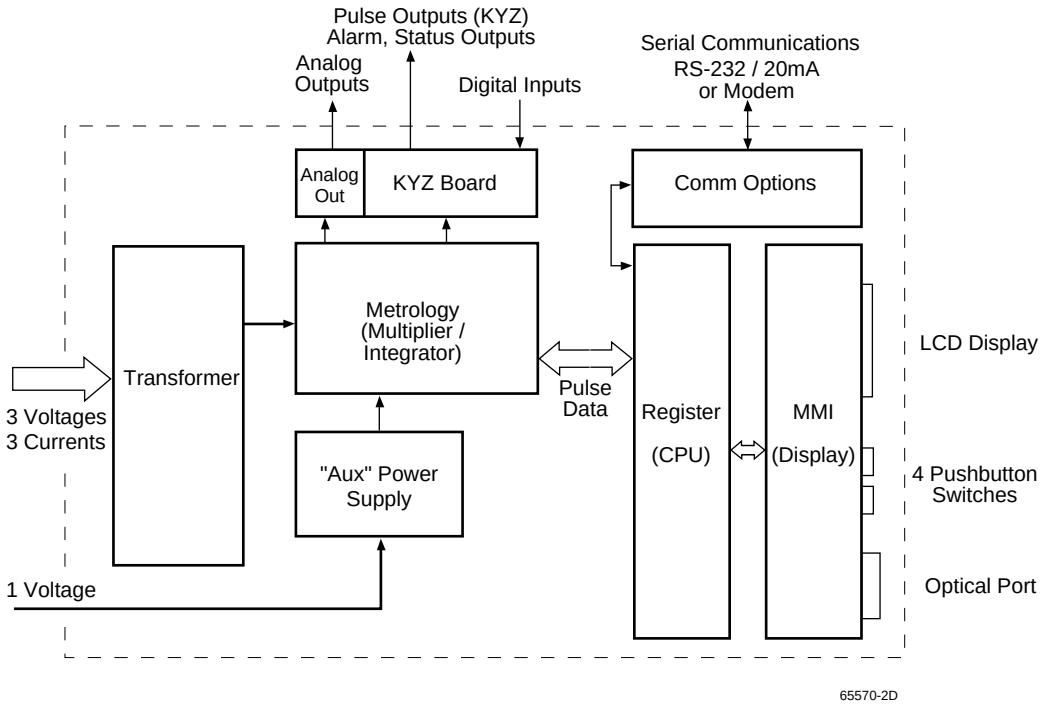
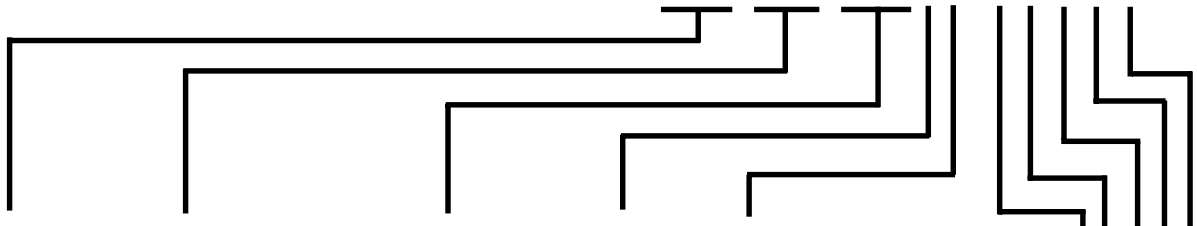


Figure 1-1
JEM10 Functional Block Diagram

1.3 Model Number Description

This is a general user manual applicable to a broad range of JEM10 meter options. To determine the options on your meter, read the model number located in the center front of the meter faceplate and compare it to the Models guide below.

TYPICAL MODEL NUMBER J10 120 05S12-NNNNN



Meter Type	Measurement Function	Form/Enclosure	Voltage	Current	Options
JEM10	**120 =** Watthour, ±Varhour **130 =** Watthour, ±Q-hour **221 =** ±Watthour, ±Varhour, V^2hour **231 =** ±Watthour, ±Q-hour, V^2hour	2-Element, 3-Wire Delta **05S =** Socket **05A =** A-Base **05R =** Switchboard 2½-Element, 4-Wire Wye **06S =** Socket **06A =** A-Base **06R =** Switchboard 3-Element, 4-Wire Wye **09S =** Socket **09A =** A-Base **09R =** Switchboard	60 Hz **0** = 69 V **1** = 120 V **2** = 240 V **3** = 277 V 50 Hz **5** = 69 V **6** = 120 V **7** = 240 V **8** = 277 V	**1** = CL10 **2** = CL20 **3** = In1* **4** = In5* **5** = CL2 *IEC Current Rating	Pulse I/O **0** = None **1** = 3 KYZ **2** = 5 KYZ **3** = Special KYZ Communication **0** = None **1** = RS-232 **2** = 20 mA **3** = Modem **4** = Power Fail Modem Option **5** = CommRepeater Analog Output **0** = None **1** = Analog ± 1.2mA **2** = Analog 4-20mA Communication Protocol **1 =** DNP 3.0 (requires CommRepeater Option) VAR Compensation **1** = VAR comp.

Table 1-1
JEM10 Model Number Explanation

1.4 Specifications

Nominal Definition

The nominal conditions as referenced in the specification are defined as follows:

Voltage = Faceplate Voltage
Current = ½ Class Amps
Power Factor = Unity Power Factor
Frequency = 60 Hz

Input Range Limits and Burdens

Current Input Class	Operation Range	Overload Imax	Burden at I_n S-, A-Base	Burden at I_n Switchboard
Class 2 (I_n1)	.001–2 A	2.4 A	.3 VA	.4 VA
Class 10 (I_n5)	.005–10 A	15 A	.1 VA	.15 VA
Class 20	.01–20 A	30 A	.35 VA	.6 VA

Voltage Inputs Voltage Ratings	V_{min}	V_{max}	Burden at $V_{nominal}$*
69	43	78	0.6 VA
120	75	135	0.1 VA
240	150	270	0.2 VA
277	173	312	0.25 VA

*Does not include auxiliary power requirements.

Overload	1.5 x rated voltage input for two seconds
Auxiliary Power	Rated voltage input ±20% (from nominal operating voltage)
Auxiliary Power Burden	10 VA maximum (normally derived from A-phase voltage input on S-base and A-base meters)

Accuracy

- **Calibration Accuracy**
  (See Glossary for definition of Calibration Accuracy.)

Watt/Watthour, Var/Varhour, Q/Q-hour	±0.1% reading
Volt-squared hour	±0.2% reading (75–135 V)

- **Load Performance**
  Maximum deviation in percent of reading from reference performance:

Class 2 (I_n1)	Class 10 (I_n5)	Class 20	P.F. = 1.0	P.F. = 0.5
0.2 A < I_t ≤ Class	1.0 A < I_t ≤ Class	2.0 A < I_t ≤ Class	0.10%	0.10%
0.1 A < I_t ≤ 0.2 A	0.5 A < I_t ≤ 1.0 A	1.0 A < I_t ≤ 2.0 A	0.10%	0.20%
0.05 A < I_t ≤ 0.1 A	0.25 A < I_t ≤ 0.5 A	0.5 A < I_t ≤ 1.0 A	0.20%	0.40%
0.02 A < I_t ≤ 0.05 A	0.1 A < I_t ≤ 0.25 A	0.2 A < I_t ≤ 0.5 A	0.30%	0.50%

Where I_t = test amps

Load performance of I_n1 and I_n5 meets or exceeds IEC specifications.

- **Power Factor Influence**
  Maximum additional error due to power factor influence is ±0.002%/P.F. for P.F. less than 0.5.

- **Temperature Operating Ranges**

External Environment	-30° C to +70° C
Under Cover	-30° C to +85° C (including solar/internal heat rise)
Storage Temperature	-40° C to +85° C
Applicable Specification	IEC 687, Clause 4.3

- **Temperature Influence on Accuracy**
  Maximum average temperature coefficient from 25° C to -30° C and 25° C to +70° C at nominal-rated inputs.

Watthour, Q-hour	±0.005% / °C
Varhour, Volt-squared hour	±0.009% / °C

- **Extended Potential Range**
  Additional error of ±0.1% for extended potential range:

Meter Voltage Range	Low	High
69 V Meter	12–43 V	78–86 V
120 V Meter	20–75 V	135–150 V
240 V Meter	40–150 V	270–300 V
277 V Meter	46–173 V	312–346 V

  (Exception noted: When auxiliary power is derived from a phase operating voltage which is typically A-phase on socket meters, the meter circuits will not work if voltage is below the specified auxiliary power minimum.)

- **Equivalence of Circuits (Balance)**
  Maximum deviation between any two circuits tested individually:
  Watt/Watthour ±0.1% from reference calibration
  Var/Varhour ±0.2% from reference calibration

- **Frequency Ranges**
  58–62 Hz (60 Hz units)
  48–52 Hz (50 Hz units)

- **Frequency Effect on Var Accuracy**
  Accuracy of Var/Varhour measurement is maintained for the frequency of calibration. Magnitude of frequency influence on the var measurement is proportional to the deviation of frequency divided by the calibration frequency.

- **Var Frequency Compensation (Optional Feature)**
  Frequency Ranges: 57 - 63 Hz (60 Hz units)
  47 - 53 Hz (50 Hz units)
  Var Accuracy: ±0.2% from ref. calibration throughout frequency range

- **Repeatability**
  A 0.02% maximum fluctuation exists between successive tests assuming constant conditions for a 36-second test.

- **Clock Accuracy**
  External tracking (line frequency): Accuracy of the clock is directly determined by the power system frequency, except during loss of auxiliary power to the meter. The internal reference accuracy is applicable for that time period.

  Internal tracking (external referenced): five seconds per day maximum error.

Other Required Qualification Ratings

- **Creep and Equivalent Settings**

  The meter does not creep. That is, no pulses or registration will occur on any function (which depends on current) with the current circuit open. The anti-creep requirement does not apply to the volt-squared-hour function.

  The meter will begin to register at loads equivalent to 0.05% of full scale. Full scale is defined as class amperes, rated voltage, and a power factor set for maximum accumulation times the number of elements.

- **External Magnetic Field**

  Less than 0.1% influence of reading with 100 A turns of 60 Hz current, six inches from the center of the meter in any direction.

- **Isolation**

From each voltage or current circuit or auxiliary power circuit to all other circuits, terminals, and case	2500 Vac minimum 60 Hz, 1 minute
From each optically isolated circuit (pulse I/O, 20 mA comm) to all other circuits, terminals, and case	1000 Vac minimum 60 Hz, 1 minute
From circuits connected to meter internal circuit ground (analog output, RS-232) to case (not isolated from one another)	1000 Vac minimum 60 Hz, 1 minute
From modem phone-line inputs to case	±225 V peak minimum
KYZ pulse outputs (To all other circuits, terminals, and case)	1000 V

- **Surge Ratings**

  This design meets the transient tests as specified by the newly developed ANSI standards.

Power Circuits	ANSI C37.90, ANSI C62.41, IEC 687
KYZs	ANSI C37.90
Analog Outputs	ANSI C37.90 (excluding fast-transient tests)
Communication Circuits	ANSI C37.90 (excluding fast-transient tests)

■ **Surge Failure Definition**
Any function of the meter ceases to operate correctly after application of the test or any spurious output during application of the test. Specifically, the meter register must not increment or generate false counts.

■ **EMI/RFI Interference Susceptibility**
As defined in draft ANSI C12.16-1991, Section 10

■ **Electrostatic Discharge**

To all exterior surfaces of the meter with cover installed, excluding terminals with connectors	15 kV (air discharge) 8 kV (contact discharge) per IEC801-2

Signal Outputs

■ **Analog Output**s (Optional Features)
<u>± 1.2 mA Option (Self Powered)</u>
A bipolar dc milliamp signal linearly proportional to each measured quantity.

Signal Level	1.2 mAdc at nominal input, 2.4 mA at full scale
Compliance Voltage	10 V maximum
Example	Under condition of maximum load at 10 A at 120 V, output is required to supply 2.4 mA into 4.16 kΩ.

<u>4-20 mA Option (Loop Powered)</u>
A bipolar (4-12-20mA) or unipolar (4-20mA) dc milliamp signal linearly proportional to each measured quantity.

Signal Level	20 mAdc at nominal input
Loop Supply Voltage	18 Vdc to 30 Vdc
Loop Drive Capability	750 Ω max. at 20mA output level

■ **Pulse Output Options**
All three-wire, KYZ outputs and two-wire, Form-A outputs are solid-state, photo-isolated, with ratings as follows:

V_{ce} (max. open-circuit voltage)	200 V, dc or peak ac
V_{sat} (max. closed-circuit saturation voltage drop)	2.5 V at 30 mA
I_c max (max. rated switching current)	50 mA
TTL-compatible output	4.7 kΩ pull-up to +5Vdc

■ **Form-A inputs**
Two-wire signal inputs require an external source of a dc current impulse to activate a photo transistor.

Minimum ON Voltage	10 V peak
Maximum ON Voltage	40 V peak
Maximum OFF Current	0.1 mA peak

- **Test Outputs**
  IRLEDs test outputs are to be provided through the optical port transmitter which becomes a test output when the meter is in the test mode.

Registers

- **Consumption Registers**
  kWh Del, kWh Rec, kvarh Del, kvarh Rec, kvarh per quadrant, V^2hour

- **Demand Registers—Maximum, Coincident, Cumulative, and Continuous Cumulative Demand**
  kW Del, kW Rec, kvar Del or kQ Del, kvar Rec or kQ Rec, kvar per quadrant (Q1, Q2, Q3, Q4), kVA Del, kVA Rec

- **Instantaneous Demand**
  kW Del, kW Rec, kvar or kQ Del, kvar or kQ Rec, kVA Del, kVA Rec

  Time of Maximum Demand
  Records the time that a maximum demand occurred

- **Status Registers**
  Store meter information: time, date, firmware version, comm setting, and health status

- **Storage Registers**
  Available for most metering registers for Demand Reset and Season Change

- **Time of Use**
  Four season schedules
  Nine day types including each day of the week and two holiday types
  Twenty-year calendar with up to 200 holidays specified
  Each measurement register can be associated with one of five time-of-use rates (A, B, C, D, and Total)
  Up to eight rate changes can be specified for each day type

- **Load Profile**
  Up to five channels of storage
  Programmable interval length (1, 2, 3, 4, 5, 6, 10, 12, 15, 30, and 60 minutes)
  68K Load Profile memory size
  70 days storage, five channels, 15-minute intervals

- **Communications**
  Three levels of Password security access (High, Low, None)
  Baud rates up to 9600 baud

- **Battery Life Expectancy**
  Lifetime of the meter over operating temperature range

- **RS-232 Specification**
  Supports Tx, Rx, Gnd, DTR, and RTS signals

- **Internal Modem**
  Compliance: CCITT: V.32 bis, V.32, V.22 bis, V.22, and V.21 along with Bell®: 212A and 103
  Speeds: 9600, 2400, 1200, and 300 bps
  Industry Standard 'AT' command set
  V.42/MNP® protocols (Error correction: V.42 and MNP® 2-4)

- **Power Fail Controller**
  Power Fail Controller option includes modem controller, power manager board and battery.

- **20 mA**
  V_{SAT} Transmitter Output = 2.7 Vdc (maximum) @ I_C = 20 mA
  V_{ON} Receiver Input = 2.75 Vdc (maximum) @ I_{IN} = 20 mA
  V_{OC} Maximum open circuit voltage compliance of current source = 27 Vdc

2. Meter Installation

2.1 Physical Dimensions

The following illustrations define the physical dimensions of the S-base, A-base, and switchboard-case meters. The S-base and A-base meters conform to ANSI standard forms.

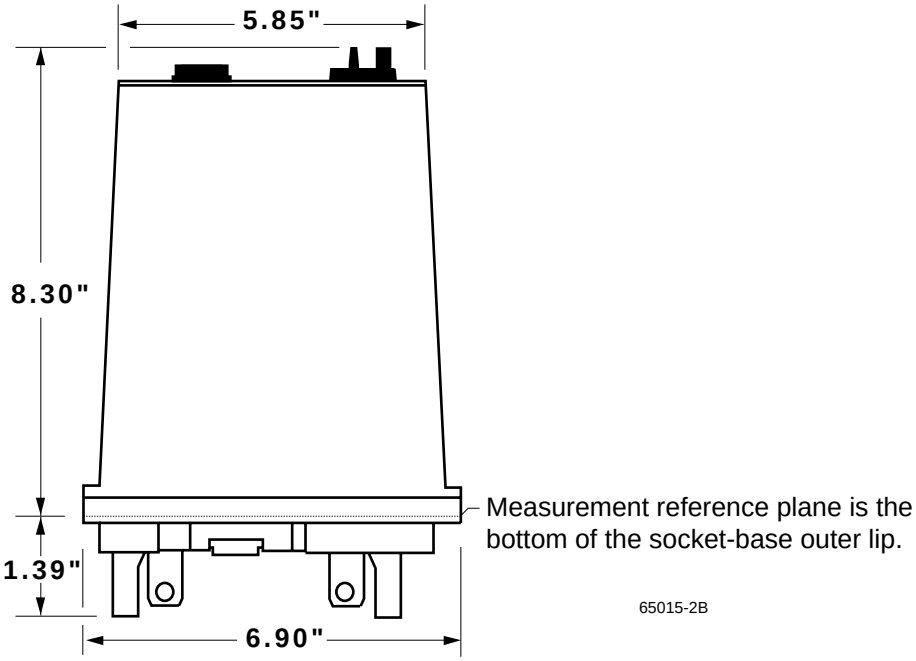


Figure 2-1
S-Base Meter Dimensions

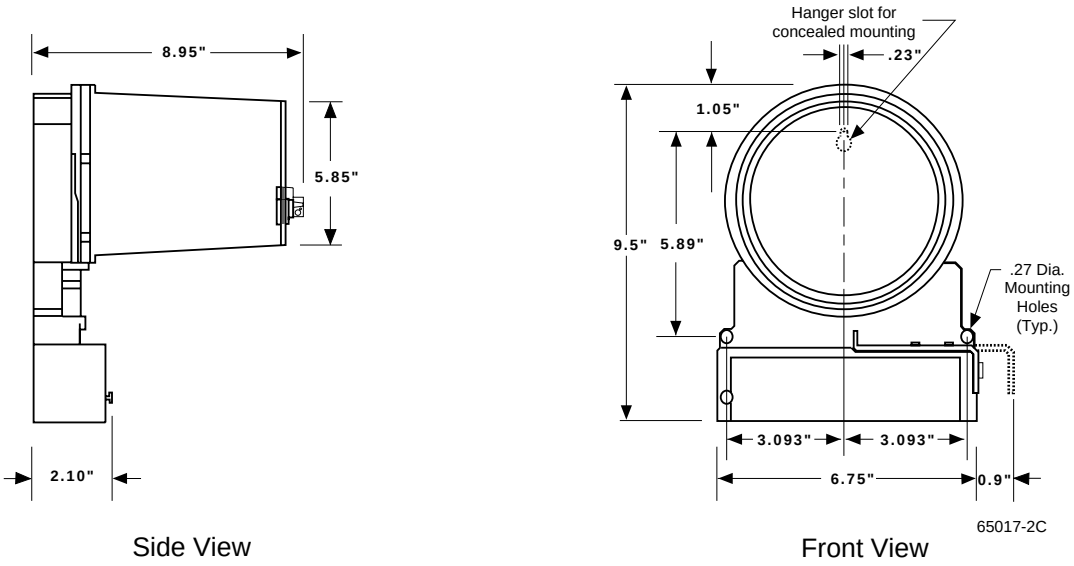


Figure 2-2
A-Base Meter Dimensions

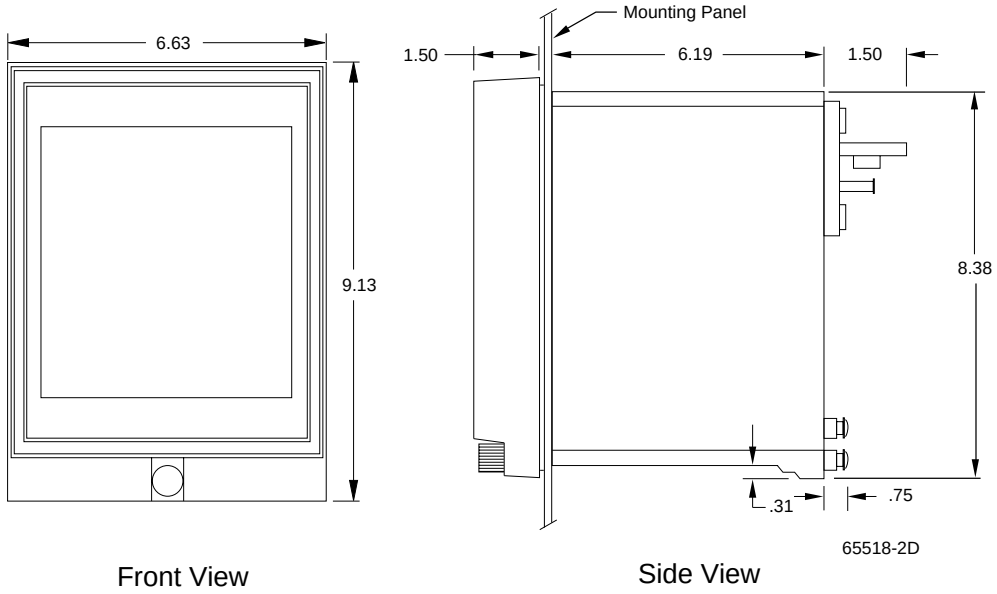


Figure 2-3
Switchboard-Case Meter Dimensions

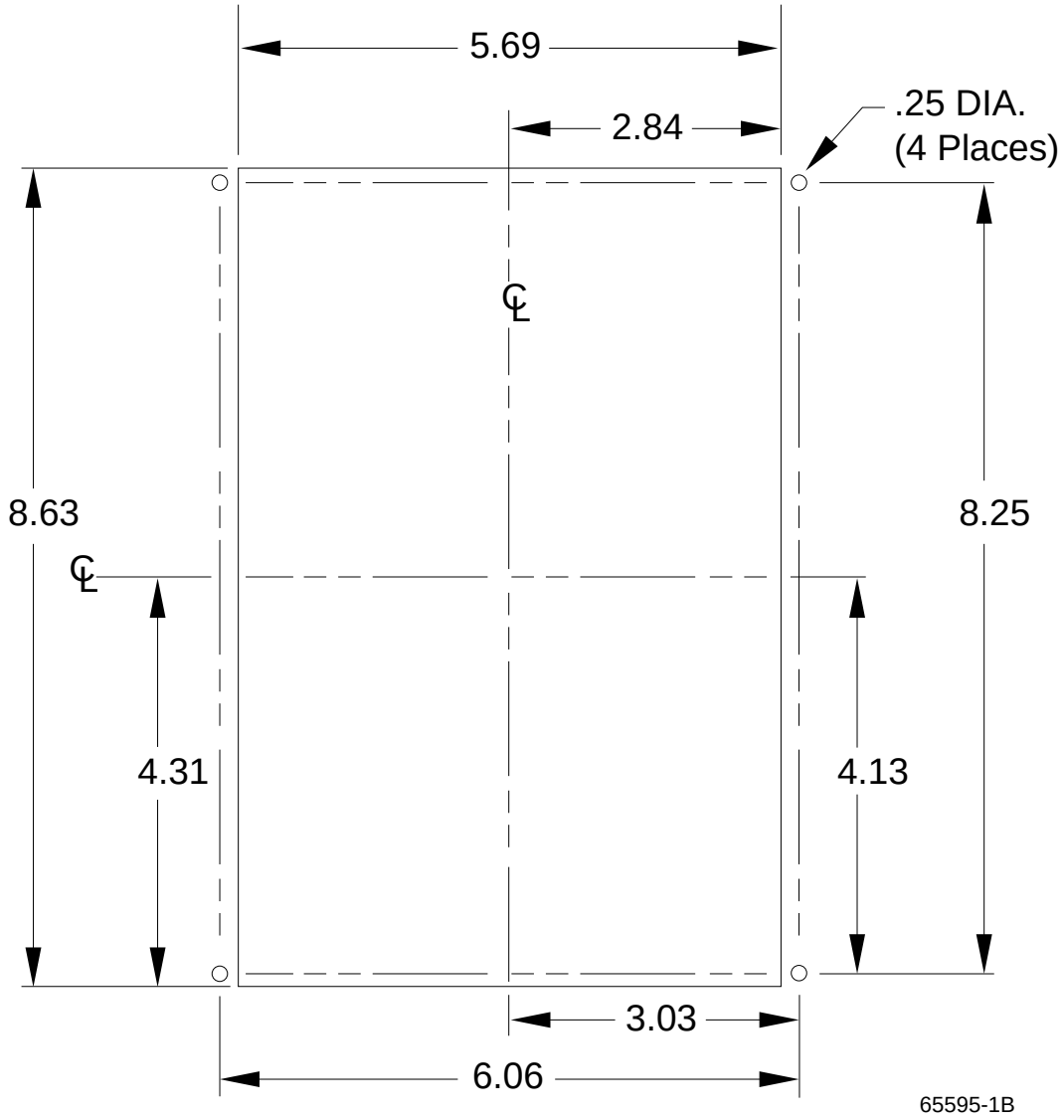


Figure 2-4
Switchboard-Case Meter Panel Cutout Dimensions

2.2 Wiring Diagrams

Form 5S 2 Element 3 Wire Delta

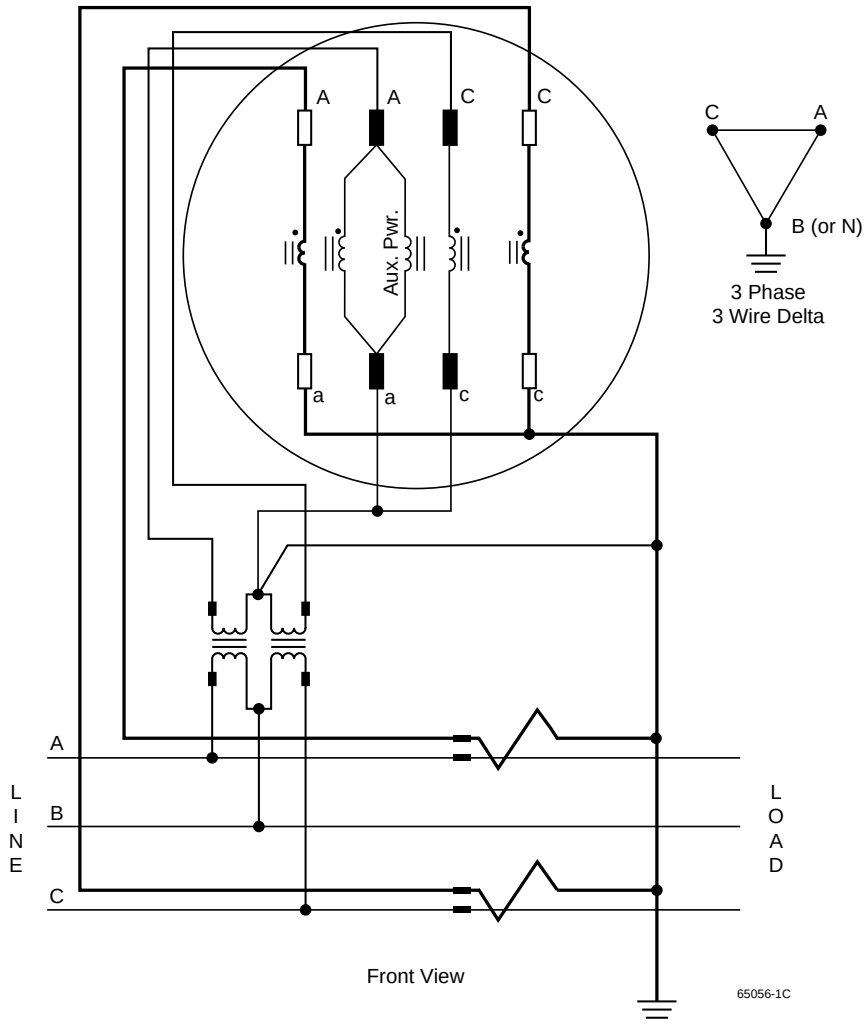


Figure 2-5
Form 5S Wiring Diagram

Form 6S 2½ Element 4 Wire Wye

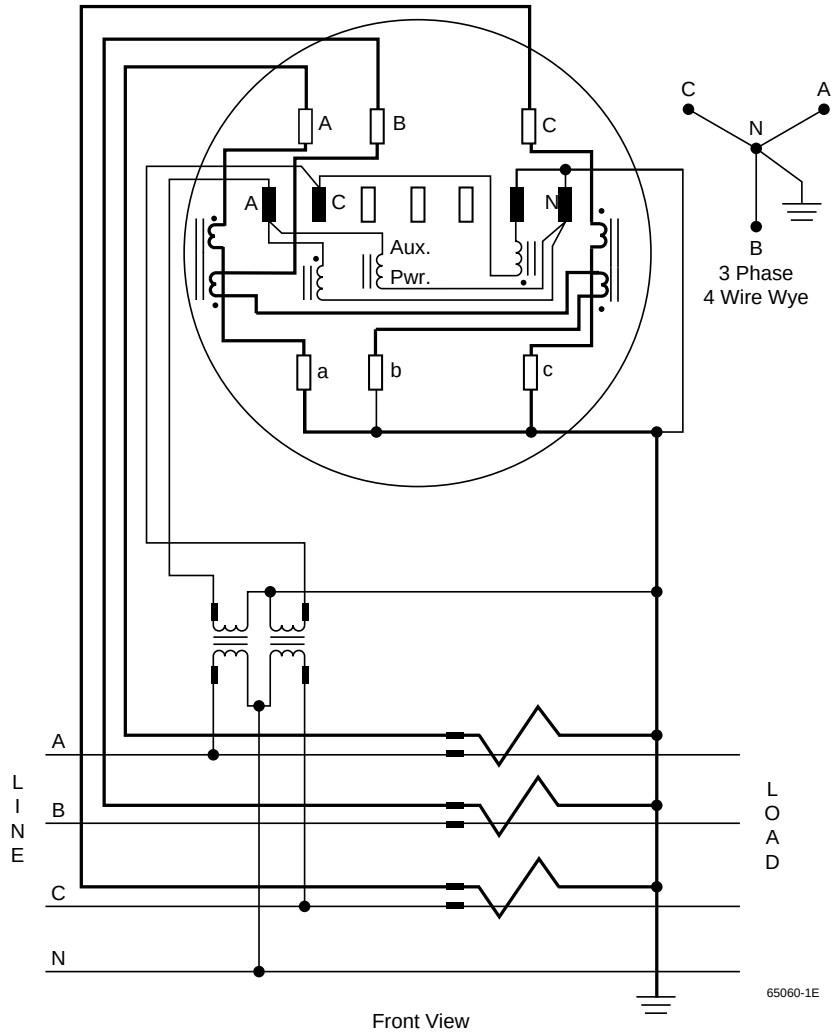


Figure 2-6
Form 6S Wiring Diagram

Form 9S 3 Element 4 Wire Wye

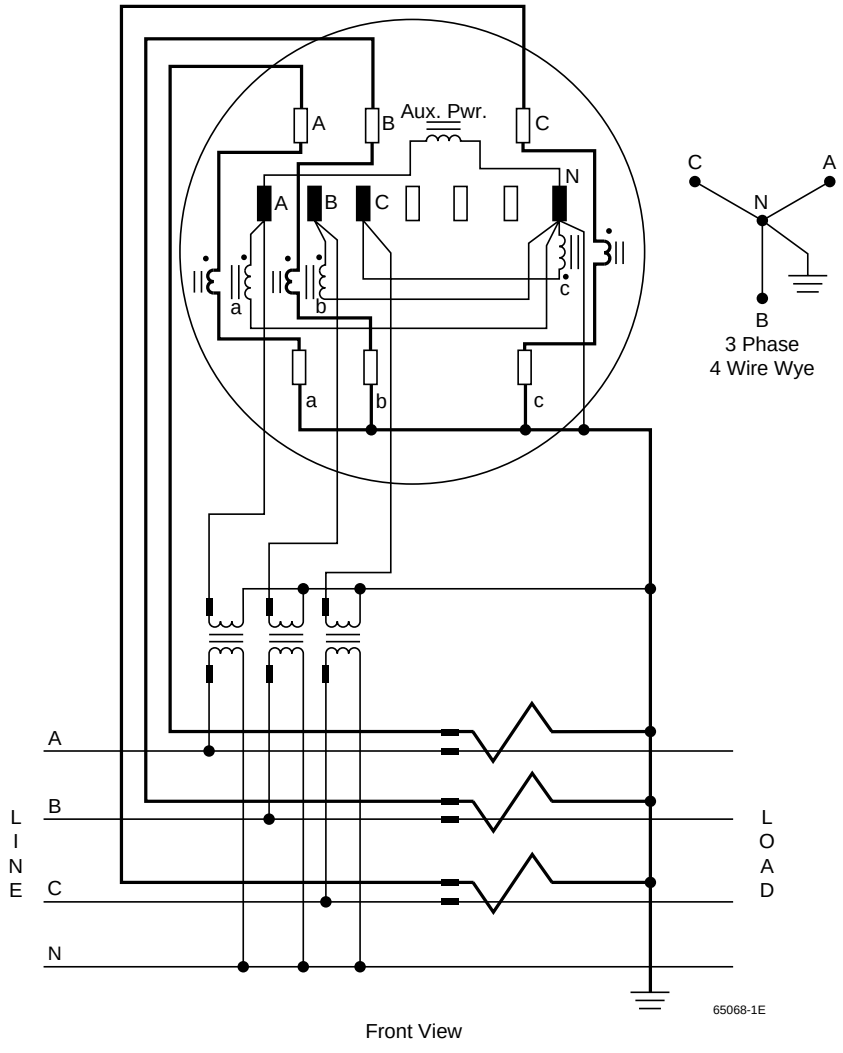


Figure 2-7
Form 9S Wiring Diagram

Form 5A 2 Element 3 Wire Delta

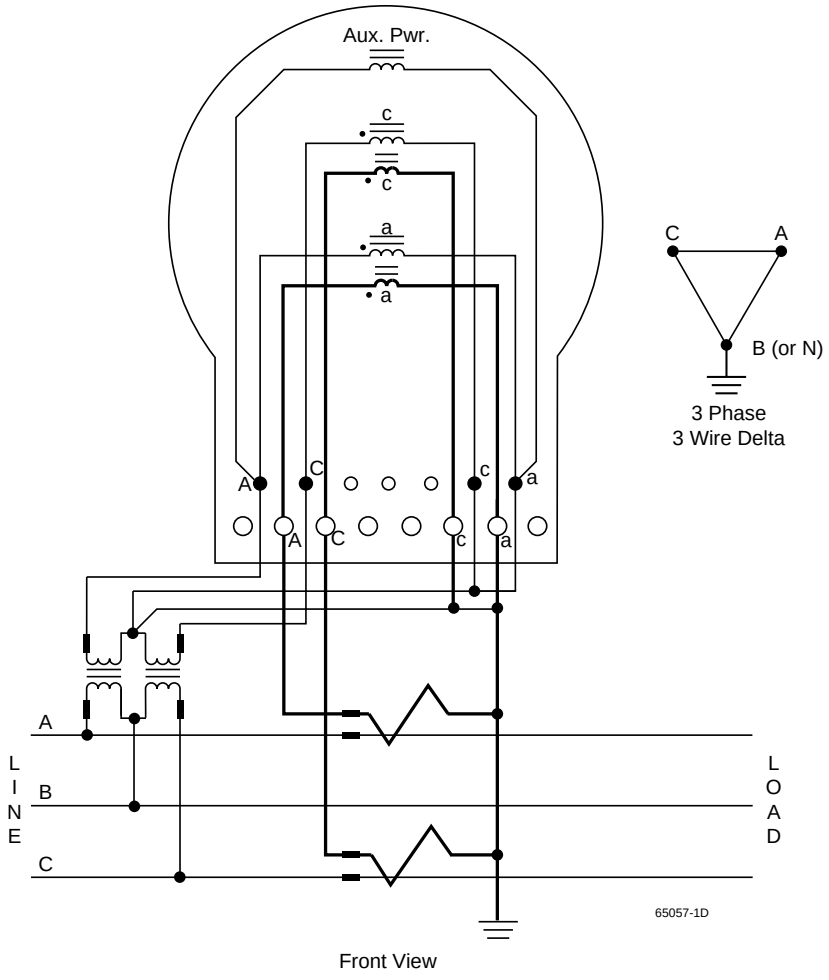


Figure 2-8
Form 5A Wiring Diagram

Form 6A 2½ Element 4 Wire Wye

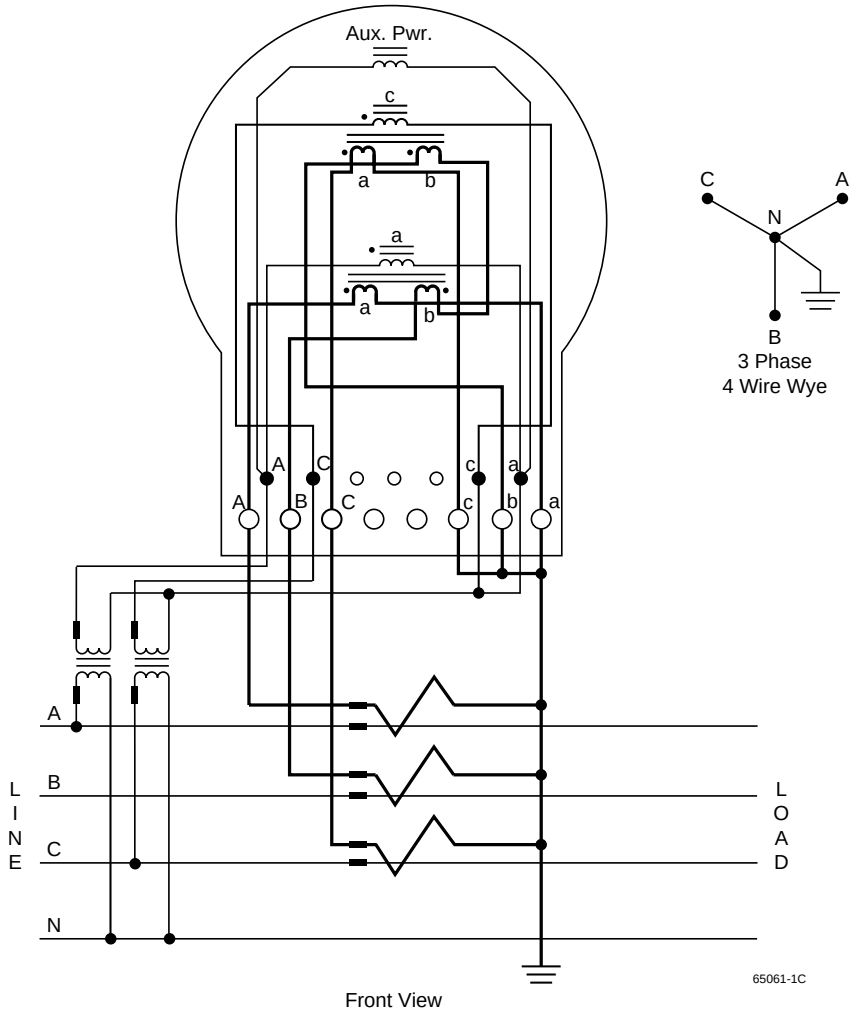
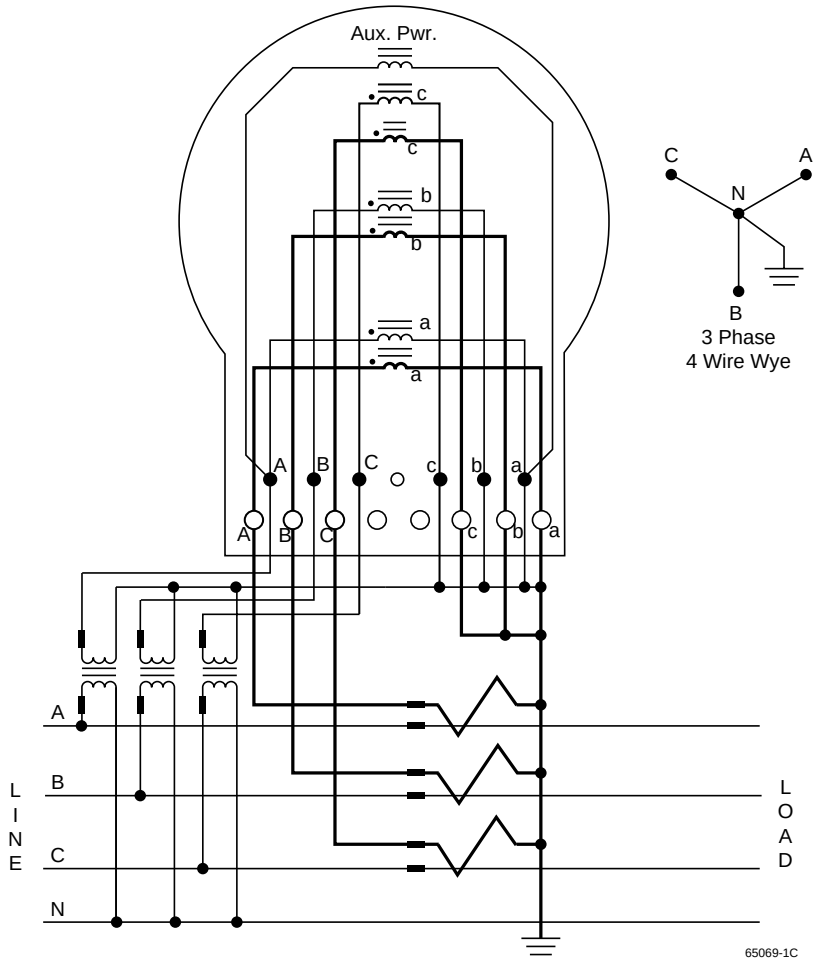


Figure 2-9
Form 6A Wiring Diagram

Form 9A 3 Element 4 Wire Wye



Front View

Figure 2-10
Form 9A Wiring Diagram

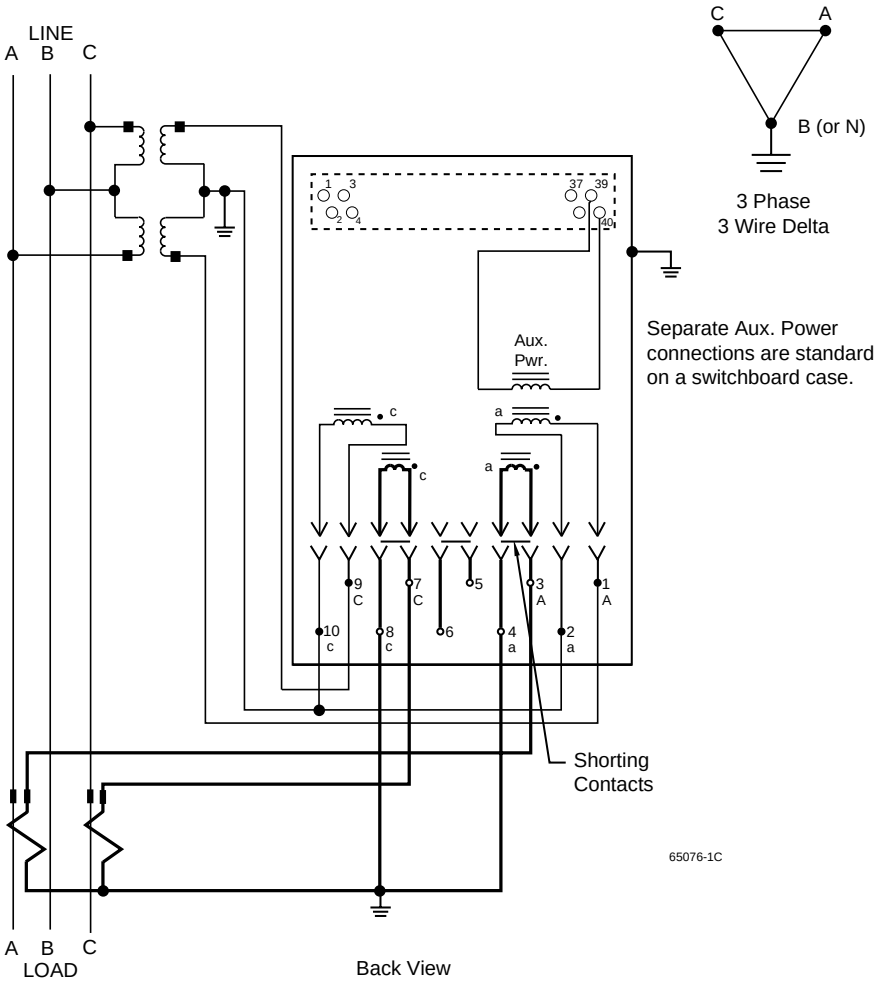


Figure 2-11
Form 5R Wiring Diagram

6R Switchboard 2½ Element 4 Wire Wye

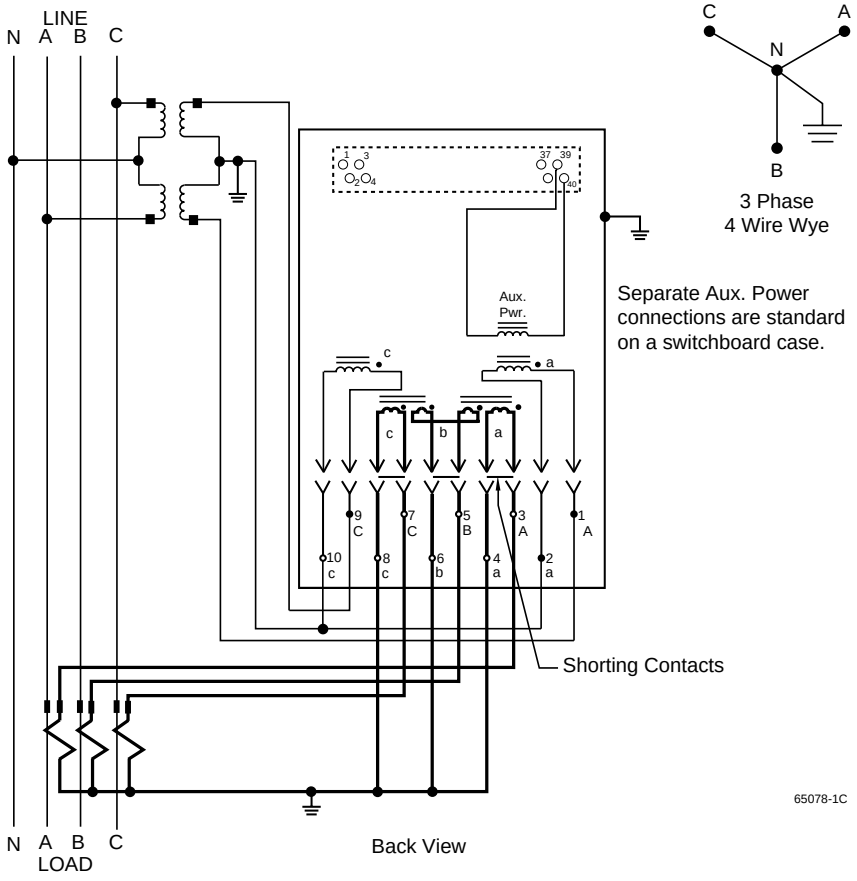


Figure 2-12
Form 6R Wiring Diagram

9R Switchboard 3 Element 4 Wire Wye

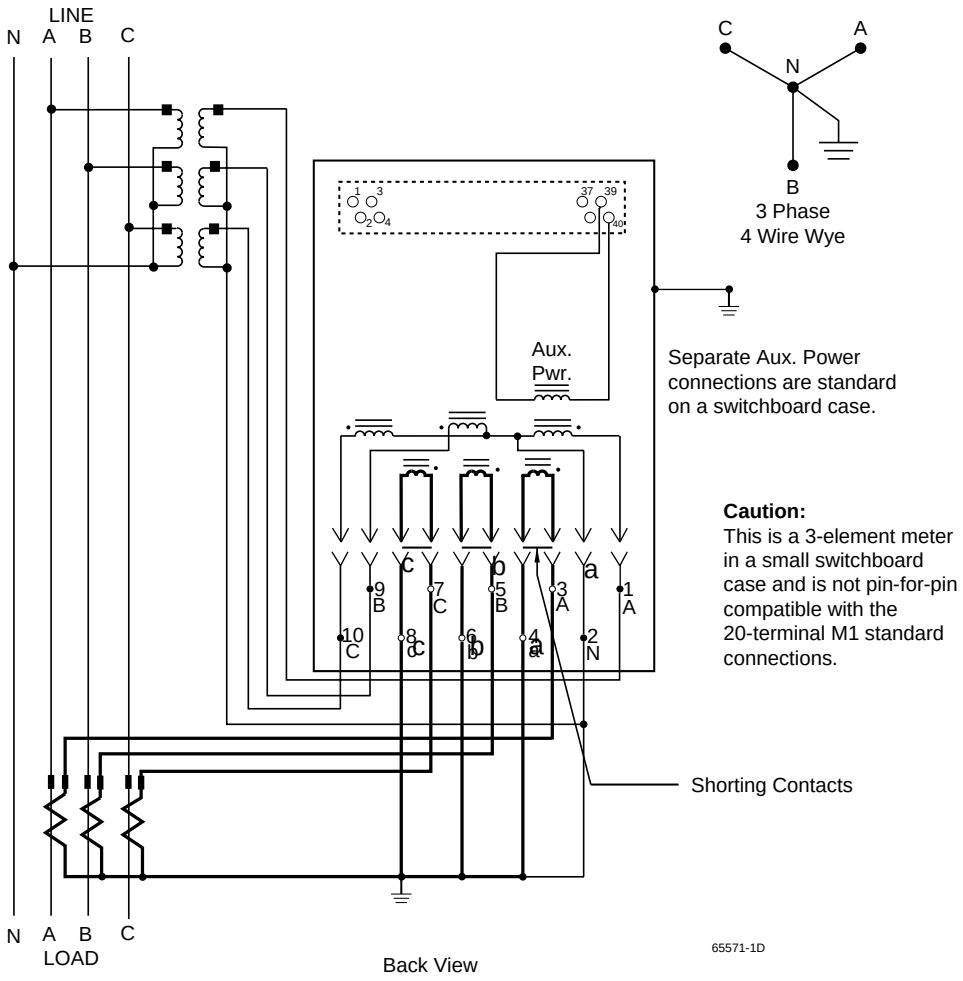


Figure 2-13
Form 9R Wiring Diagram

Grounding Recommendations

It is extremely important to ensure proper grounding for the JEM10 meter. For full meter protection, supply an adequate, low-impedance ground to the JEM10 and verify with an ohm meter. Be sure not to make grounding connections on painted surfaces. All output cables from the JEM10 should be shielded cables with the shield grounded at one end. The instrument PT and CT commons should be grounded consistent with your company's wiring procedures.

2.3 Option Connections

The following section provides installation information for options available on the JEM10 meter.

KYZ Option

Pulse-initiator (KYZ) outputs are Form-C, three-wire contact closures based on the configured K_e of the meter. Up to five channels of KYZ outputs are assigned to the basic measured consumption quantities: ±watthours, ±varhours (or Q-hours), and volt-squared hours. Each of the five KYZ channels can be configured using JEMSET with its own pulse value.

Figure 2-14, KYZ Port Location Diagram, illustrates that the KYZ port is located on the back of S-base meters, and on the right side behind the globe (facing the meter's display) on A-base meters in the form of a 24-pin dual in-line pin connector. On switchboard-case meters, connections are made on the terminal connector on the back of the case in positions 1 to 24.

Status/Alarm Output

A Form-A (two-wire) signal output can be configured using JEMSET as an end-of-demand-interval pulse, demand-threshold alarm, or potential loss alarm. This opto-isolated output is available on the same connector as the KYZs.

Input End-of-Demand-Interval Pulse

A master demand sync can be connected to the input (EODIP) Form-A connection. This will synchronize the demand intervals and load-profile intervals to the incoming pulse. The meter must be configured using JEMSET with External Demand Sync enabled for this to be operational.

Input Time Synchronization Pulse

A Time Synchronization Pulse can be connected to the JEM10 input channel (Y7, K7), which will allow synchronization of the meter's time to an external standard. Synchronization will occur at the trailing edge of the sync pulse, which should be timed at 30 minutes and 30 seconds past the hour. The meter will accept a pulse within a 20 second window (+ or - 10 seconds, from HH:30:20 to HH:30:40).

The sync pulse can be generated from any contact closure (or solid state device) switching an external DC voltage of 10 to 40 Vdc. Pulse width should be a minimum of 1 mS. The input resistance of the input channel is 2200 ohms nominal.

The time sync option is available on JEM10 firmware version 3.10 and higher. Refer to the JEMSET Software instruction manual for configuration details.

Note: The Time Synchronization Pulse is not recorded as a Time Set event in Load Profile, and therefore will not close the Demand Interval. If there is any difference between the JEM10 clock and the Time Sync Pulse, the length of the Demand Interval will be adjusted accordingly.

The Time Sync Input uses the same input channel as the Demand Sync input, therefore during a configuration only one, if any, of the sync input options may be enabled.

KYZ Connector Pinout

Pin	Color	Channel	A-Base, S-Base, Switchboard-Case Function
1	Blu/Wht	Y6	Output : EODIP or Potential Alarm or Demand Threshold Alarm
3	Blu	K6	Output : EODIP or Potential Alarm or Demand Threshold Alarm
5	Brn/Wht	Y1	Watts Delivered
7	Brn	K1	Watts Delivered
9	Brn/Blk	Z1	Watts Delivered
11	Red/Wht	Y2	Reactive Received
13	Red	K2	Reactive Received
15	Red/Blk	Z2	Reactive Received
17	Orn/Wht	Y3	Reactive Delivered
19	Orn	K3	Reactive Delivered
21	Orn/Blk	Z3	Reactive Delivered
23			Unused
2	Yel/Wht	Y4	Watts Received
4	Yel	K4	Watts Received
6	Yel/Blk	Z4	Watts Received
8	Grn/Wht	Y5	Volts²
10	Grn	K5	Volts²
12	Grn/Blk	Z5	Volts²
14	Gry/Wht	Y8	Reserved
16	Gry	K8	Reserved
18	Vio/Wht	Y7	Input: External Demand Sync or Time Sync
20	Vio	K7	Input: External Demand Sync or Time Sync
22	Blk	Shield	Shield
24			Unused
(K = Common)			

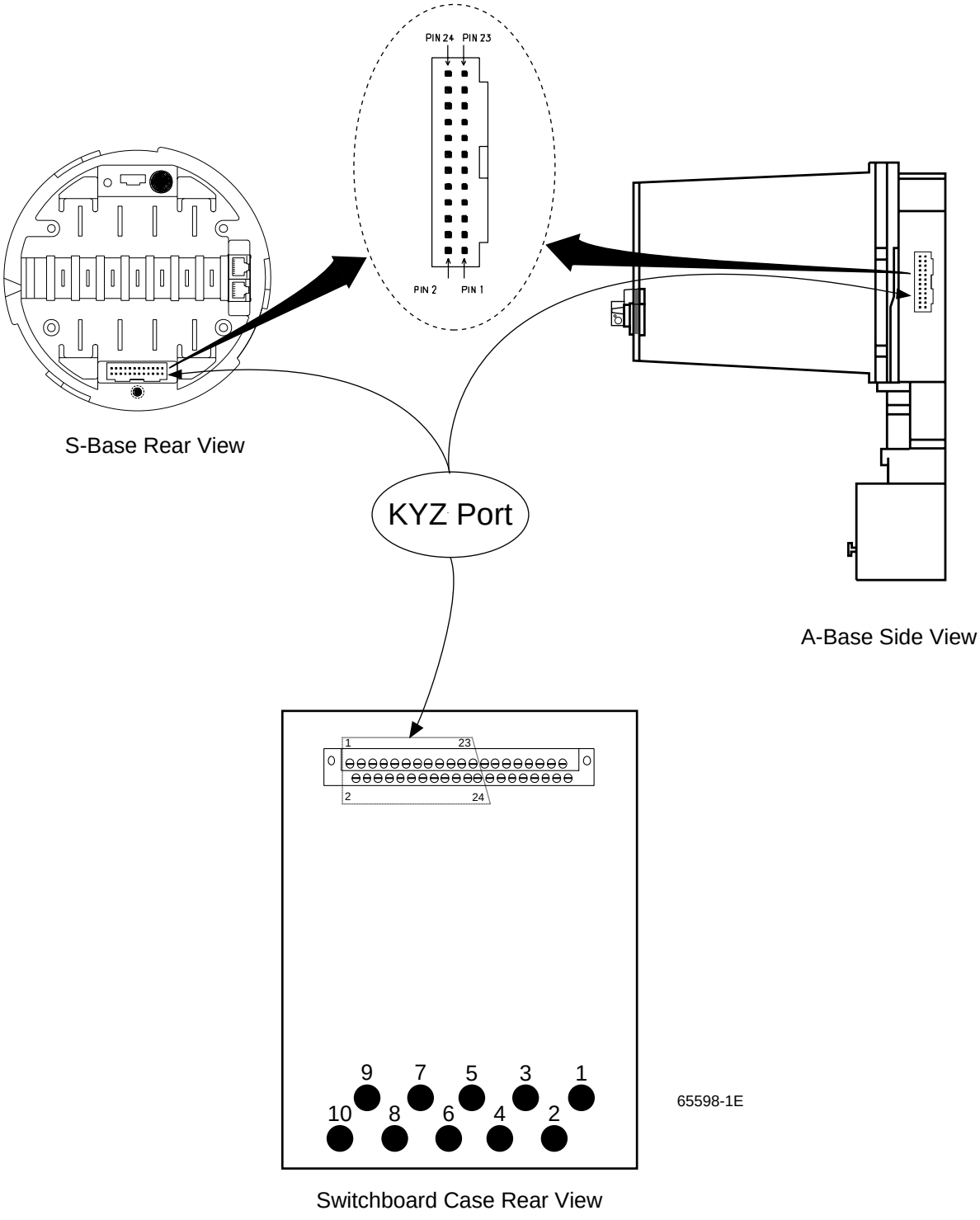


Figure 2-14
KYZ Port Location

Analog Output

The meter transmits analog-output signals from the analog-output option board. Three current-output signals can be supplied to panel meters or RTUs for SCADA applications. The return signals have a common connection.

Each analog output is proportional to one of the basic measured quantities: watt, var (or Q), and volt squared. The signals are bidirectional when the meter is specified with a bidirectional function. The signal level will be 2.4 mAdc at full-scale (nominal voltage and class amperes) polyphase watts, var, and Q. For volts squared, the signal is 1.2 mAdc at nominal voltage input.

The analog-output port is a six-pin modular jack located next to the communication-option port at the base of the meter.

Figure 2-15, Analog-Output Port Location Diagram, illustrates that the analog-output port is located at the back of the S-base meters, and on the left side behind the globe (facing the meter's display) on A-base meters. The RJ-12 connector is the smaller of the two connectors on the meter. On a switchboard-case meter, the connections are on terminal positions 23 to 28. The color codes referenced in the Analog-Output Connector Pinouts Table below are for the Scientific Columbus RJ-12 to pigtail cable, part number 15389-001.

Analog-Output Connector Pinouts

A-Base, S-Base	Switchboard Case	Color Code	Function
1	**28**	**Wht**	**Analog Out 1 (Watts)**
2	**27**	**Blk**	**Analog Out 2 (Reactive)**
3	**26**	**Red**	**Analog Out 3 (V^2)**
4	**25**	**Grn**	**Analog Out-Return**
5	**24**	**Yel**	**Analog Out-Return**
6	**23**	**Blu**	**Analog Out-Return**

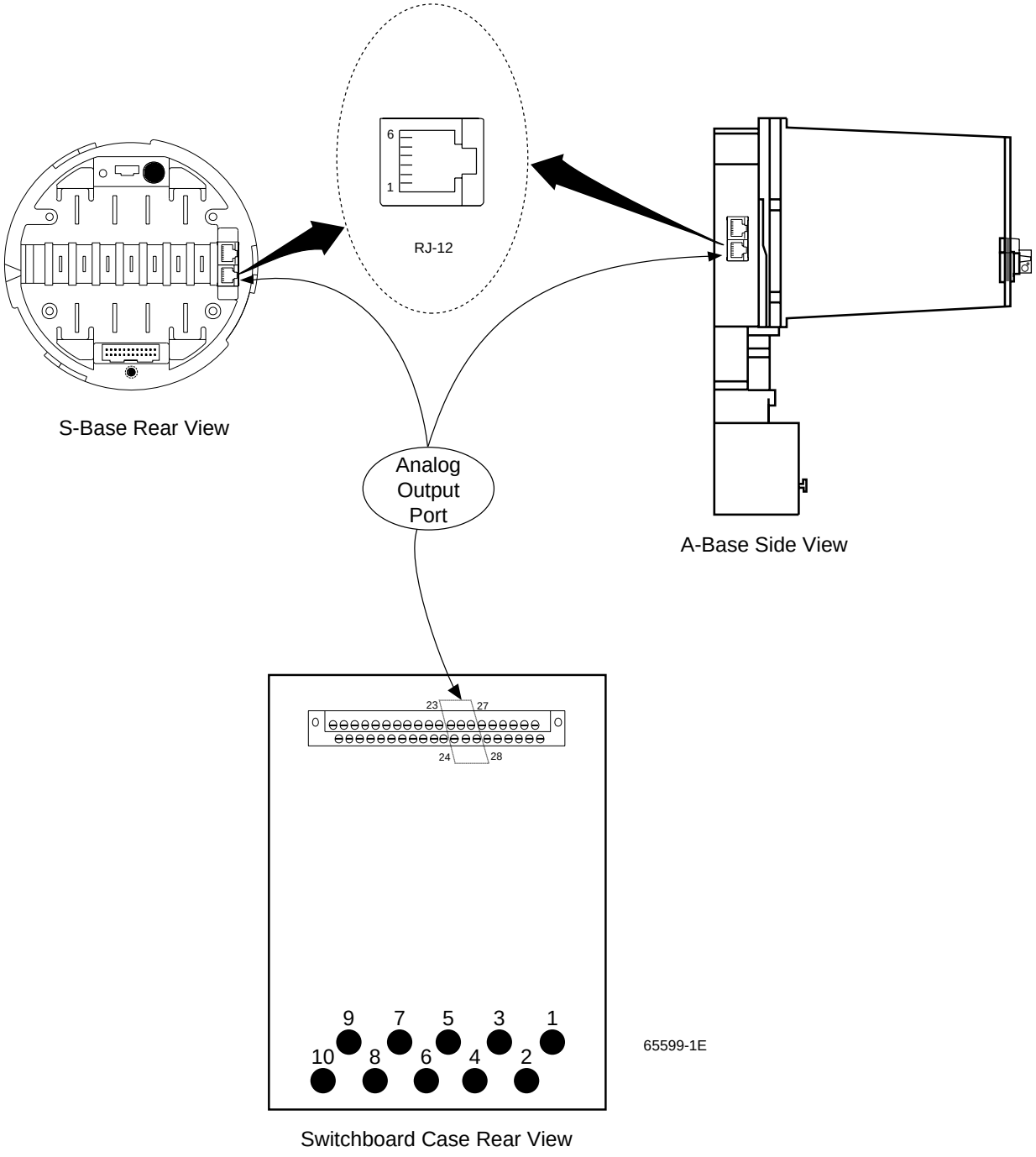


Figure 2-15
Analog-Output Port Location

Serial Communications

The serial-communications option signals are accessible from an RJ-45 eight-position modular jack located at the base of the A-base and S-base meters. On switchboard-case meters, the signals are accessible from the options connector located on the back of the case. The serial-communications option can be either RS-232, 20 mA, or modem. A standard eight-pin modular RJ-45 to RJ-45 is the standard cable used for communicating to a JEM10 through the option board. Scientific Columbus offers connectors to convert the RJ-45 plug for a variety of applications including direct PC and modem connections. Refer to Appendix B for a description and part number for the various cables and connectors. For the internal modem option, it is important to use the RJ-45 connector instead of the analog output's RJ-12 connector. Figure 2-17 illustrates hookup diagrams for a JEM10 with 20 mA current-loop comm option.

The following serial-port pinout tables list the pinouts of the meter for each of the different type of meter options. They also list the modem and PC pinouts for external RS-232 connections. External RS-232 devices can easily be connected to the JEM10 by using the modular cable and the Scientific Columbus modular connector adapter. The connector part number is listed at the bottom of the external RS-232 connection columns. To determine the required pinout for external RS-232 devices, follow each row across the table from the meter pinout on the left side of the table to the desired external RS-232 connection pinout.

A-Base and S-Base Serial Port Connections

	Meter Options Connections				External RS-232 Pinout Connections				
A-BASE S-BASE Pinout	Color Code*	RS-232 Option	20 mA Option	Internal Modem	Direct to PC (DB9-F)	External Modem (DB9-M)	Direct to PC (DB25-F)	External Modem (DB25-M)	Color Code**
1	GRY	(RI)	R+	N.C.	9 (RI)	9 (RI)	22 (RI)	22 (RI)	BLU
2	ORN	(SHLD)	N.C.	Reserved	N.C.	N.C.	N.C.	N.C.	ORN
3	BLK	(Tx)	N.C.	Reserved	2 (Rx)	3 (Tx)	3 (Rx)	2 (Tx)	BLK
4	RED	(DTR)	R-	RING	6 (DSR)	4 (DTR)	6 (DSR)	20 (DTR)	RED
5	GRN	(RTS)	T+	TIP	8 (CTS)	7 (RTS)	5 (CTS)	4 (RTS)	GRN
6	YEL	(Rx)	N.C.	Reserved	3 (Tx)	2 (Rx)	2 (Tx)	3 (Rx)	YEL
7	BLU	(Gnd)	N.C.	Reserved	5 (Gnd)	5 (Gnd)	7 (Gnd)	7 (Gnd)	BRN
8	BRN	(DCD)	T-	N.C.	1 (DCD)	1 (DCD)	8 (DCD)	8 (DCD)	WHT
Connector Part Number	15387-001				4195-475			4195-528	

* Color code for Scientific Columbus RJ-45 to pigtail cable, part number 15387-001

**Color code for Scientific Columbus cable, part number 4195-528

Switchboard-Case Serial Port Connections

	Meter Options Connections				External RS-232 Pinout Connections				
Switch-board Pinout	Color Code*	RS-232 Option	20 mA Option	Internal Modem	Direct to PC (DB9-F)	External Modem (DB9-M)	Direct to PC (DB25-F)	External Modem (DB25-M)	Color Code**
36	GRY	(RI)	R+	N.C.	9 (RI)	9 (RI)	22 (RI)	22 (RI)	BLU
35	ORN	(SHLD)	N.C.	Reserved	N.C.	N.C.	N.C.	N.C.	ORG
34	BLK	(Tx)	N.C.	Reserved	2 (Rx)	3 (Tx)	3 (Rx)	2 (Tx)	BLK
33	RED	(DTR)	R-	RING	6 (DSR)	4 (DTR)	6 (DSR)	20 (DTR)	RED
32	GRN	(RTS)	T+	TIP	8 (CTS)	7 (RTS)	5 (CTS)	4 (RTS)	GRN
31	YEL	(Rx)	N.C.	Reserved	3 (Tx)	2 (Rx)	2 (Tx)	3 (Rx)	YEL
30	BLU	(Gnd)	N.C.	Reserved	5 (Gnd)	5 (Gnd)	7 (Gnd)	7 (Gnd)	BRN
29	BRN	(DCD)	T-	N.C.	1 (DCD)	1 (DCD)	8 (DCD)	8 (DCD)	WHT
Connector Part Number	15387-001				4195-475			4195-528	

* Color code for Scientific Columbus RJ-45 to pigtail cable, part number 15387-001

**Color code for Scientific Columbus cable, part number 4195-528

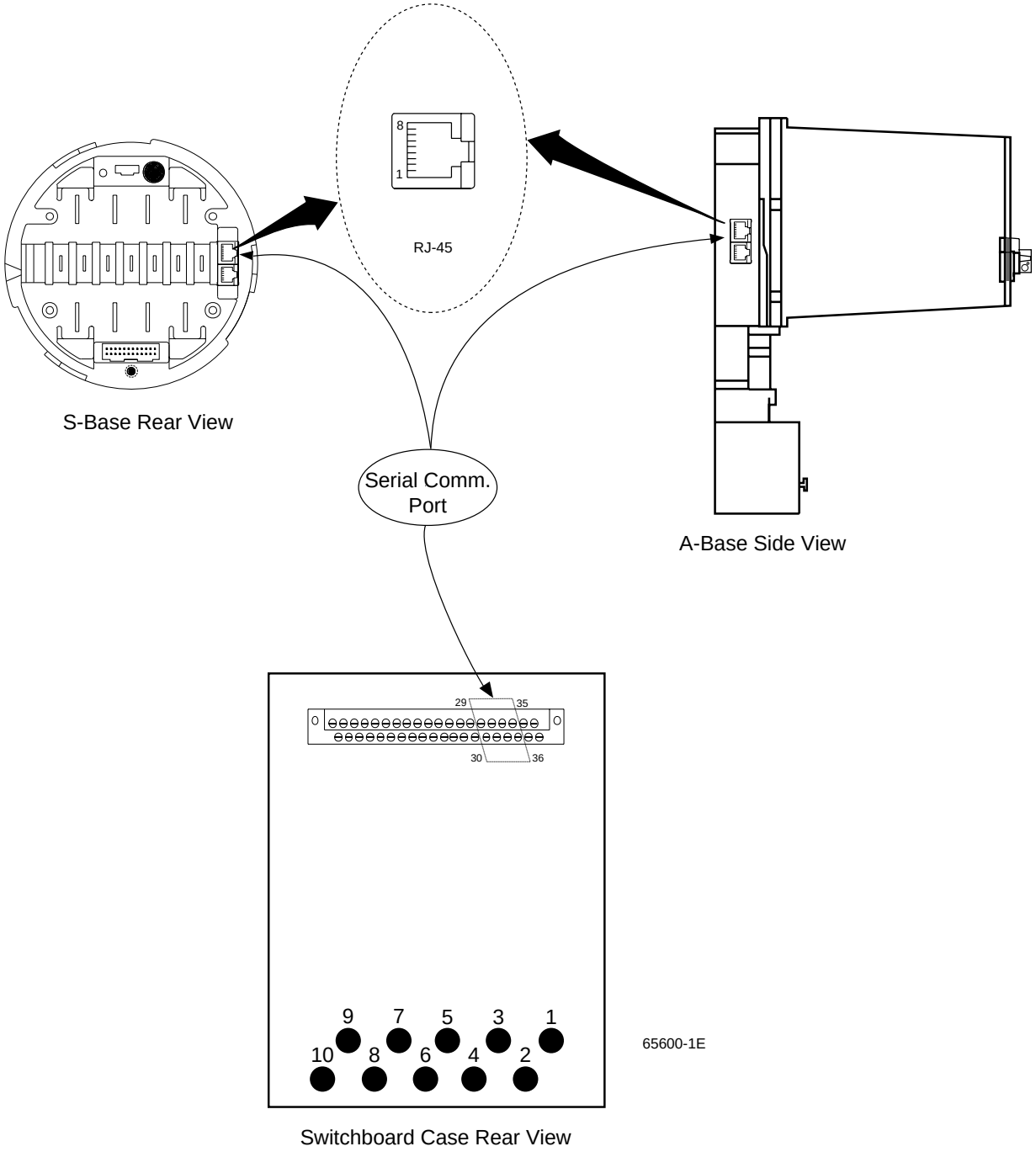
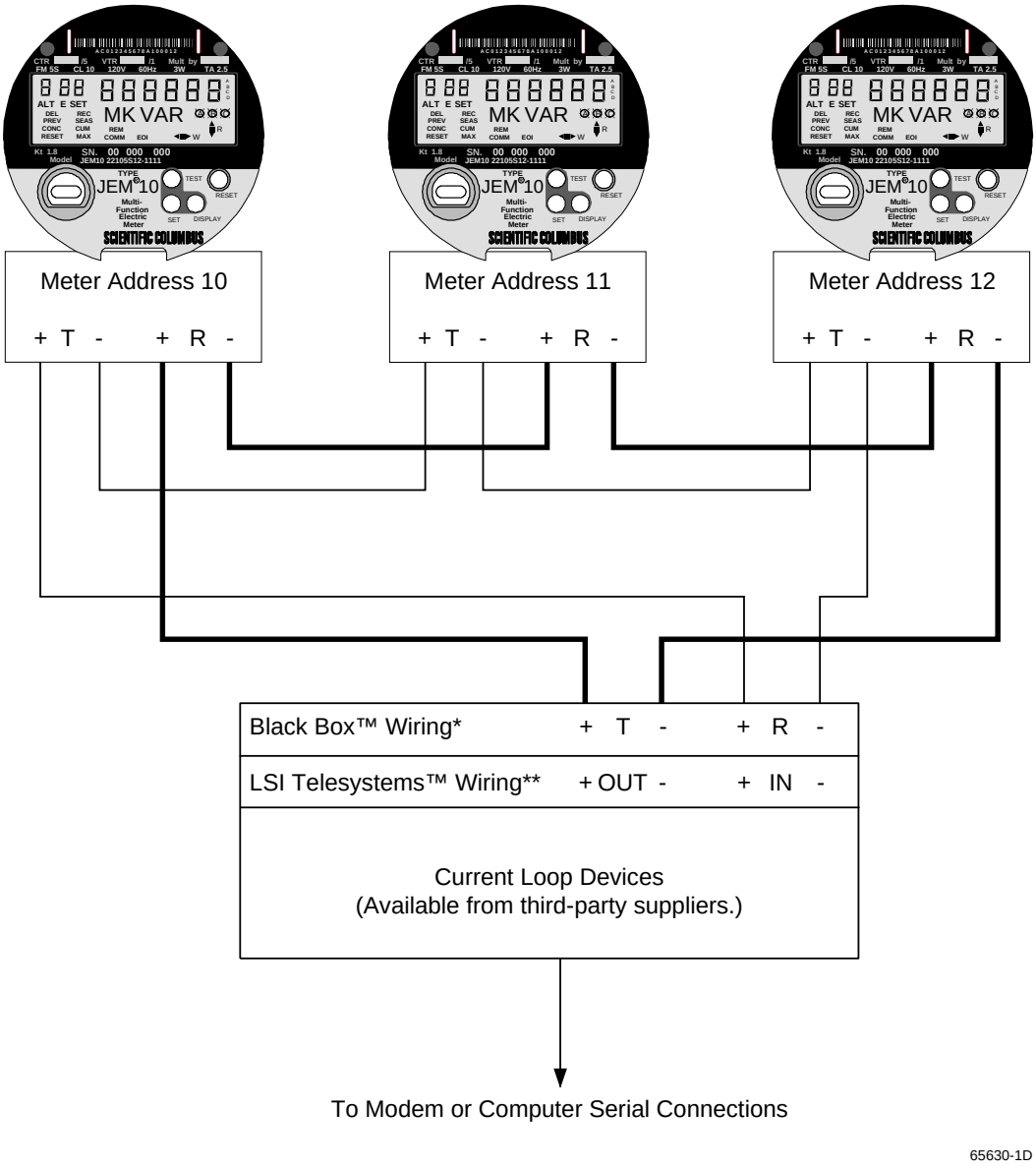


Figure 2-16
Serial Comm Port Location


Meter Address 10
+ T - + R -
Meter Address 11
+ T - + R -
Meter Address 12
+ T - + R -
Black Box™ Wiring* + T - + R -
LSI Telesystems™ Wiring** + OUT - + IN -
Current Loop Devices
(Available from third-party suppliers.)
To Modem or Computer Serial Connections
65630-1D

* Black Box is a trademark of Black Box Co.
** LSI Telesystems is a trademark of LSI Telesystems Co.

Figure 2-17
JEM10 20 mA Connection Diagram

CommRepeater Communications Module

The CommRepeater Option can be set up in one of the following modes of operation. Refer to Section 3.11 for application information.

■ RS232 Repeater Mode

RS232 Repeater Mode is configured by placing the two 16-pin DIP jumpers into sockets J1 and J2. In this mode, COMM1 must be connected to the master side of the communications link. The master is the device that initiates communications. For example, it may be a PC or a modem that is accessed by a PC. Slave devices, such as additional JEM10 meters must be connected to COMM2.

■ RS485 Mode

RS485 Mode is configured by placing the two 16-pin DIP jumpers into sockets J3 and J4. If the meter is at one of the extreme ends of the RS485 network, turn the RS485 terminators on by moving all four DIP switches of S1 to the "ON" position.

IMPORTANT!

In order for the meter to respond properly in RS485 mode, it is necessary to change one of the communications timing parameters. *This configuration must be done in RS232 mode or via the optical port.* Using JEMSET, change the RTS-to-TXD delay to at least 50 milliseconds. It is permissible to use longer delay times if the application so requires, but the minimum must be 50 milliseconds. It does not matter which port is on the master side as both ports are effectively wired in parallel in this mode.

■ RS232 to RS485 Conversion Mode

RS232 to RS485 Conversion Mode is configured by placing the two 16-pin DIP jumpers into sockets J1 and J4. This mode is appropriate for use where an RS232 master will be communicating with JEM10 meters on an RS485 network. COMM1 is the RS232 input on the master side. COMM2 is the RS485 output on the slave side. If this meter is on one of the ends of the RS485 network, the RS485 terminators must be switched on by moving all four DIP switches of S1 to the "ON" position.

Configuration

The location of setup components is noted in Fig 2-18. The operating mode of the JEM10 CommRepeater is selected by placing jumpers in the appropriate sockets on the board. Select the operating mode per Table 1.

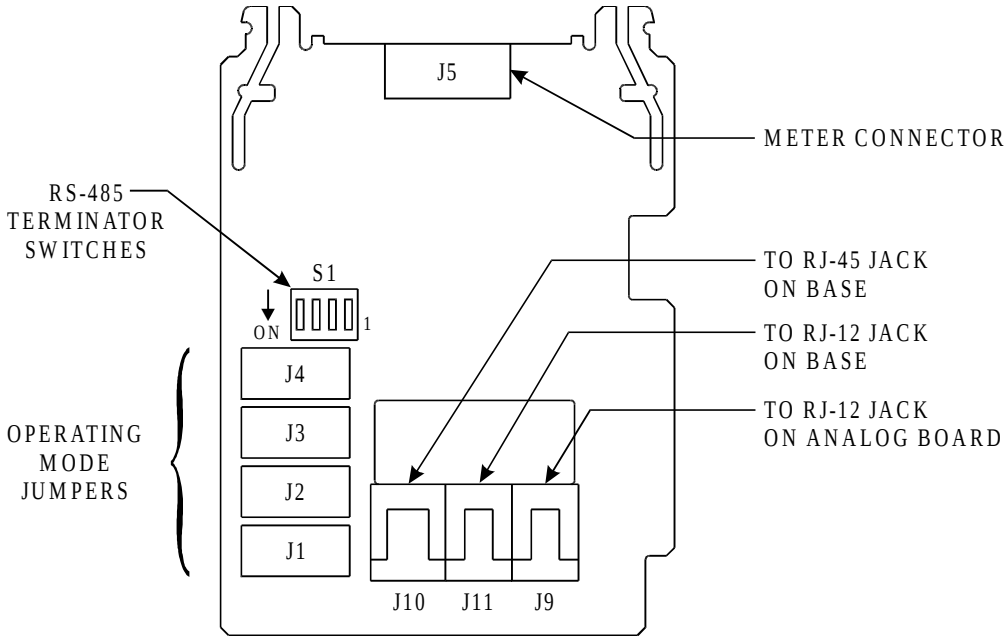


Figure 2-18
CommRepeater Module Component Locations

Table 1 - Operating Mode Selection

Desired Operating Mode	Jumper Placement
RS232 Repeater Mode	J1, J2
RS485 Mode	J3, J4
RS232 to RS485 Conversion Mode	J1, J4

DIP Switch S1 is used to turn the RS485 line terminators on or off. If all four switches are in the “ON” position, the terminators are switched in. If the switches are in the “OFF” position, the terminators are disconnected.

User Connections

The user connections for the JEM10 CommRepeater are unique for this option. Therefore, *pin assignments for other options listed in Section 2 are not valid for the JEM10 CommRepeater option.* Pin-outs of the RJ-45 and RJ-12 connectors for A-Base and S-Base meters equipped with the CommRepeater option are shown in Table 2. Pin-outs for Switchboard Case meters equipped with the CommRepeater option are shown in Table 3.

To simplify user connections, the JEM10 CommRepeater comes equipped with a cable adapter that separates the signals into two separate communications ports and one analog output port. One side of the adapter box has two connectors: one RJ-45 serial port and one RJ-12 analog port. Two cables are used to make the connection between the modular connectors on the adapter box and modular connectors on the A-base and S-base meters. Refer to Figures 2-19 and 2-20. The adapter box can also be used with pigtail cables for terminal block connections on switchboard meters, as shown in Figure 2-21. With the adapter box connected, the pin-outs of the three sockets are shown in Table 4. The pin-outs of the adapter box make it possible to connect meters together with standard straight-through cables terminated with RJ-45 jacks. When used in the RS232 mode, the Scientific Columbus RJ-45 to 9-pin "D" connector cable may be used to connect the meter from COMM1 to a personal computer or modem.

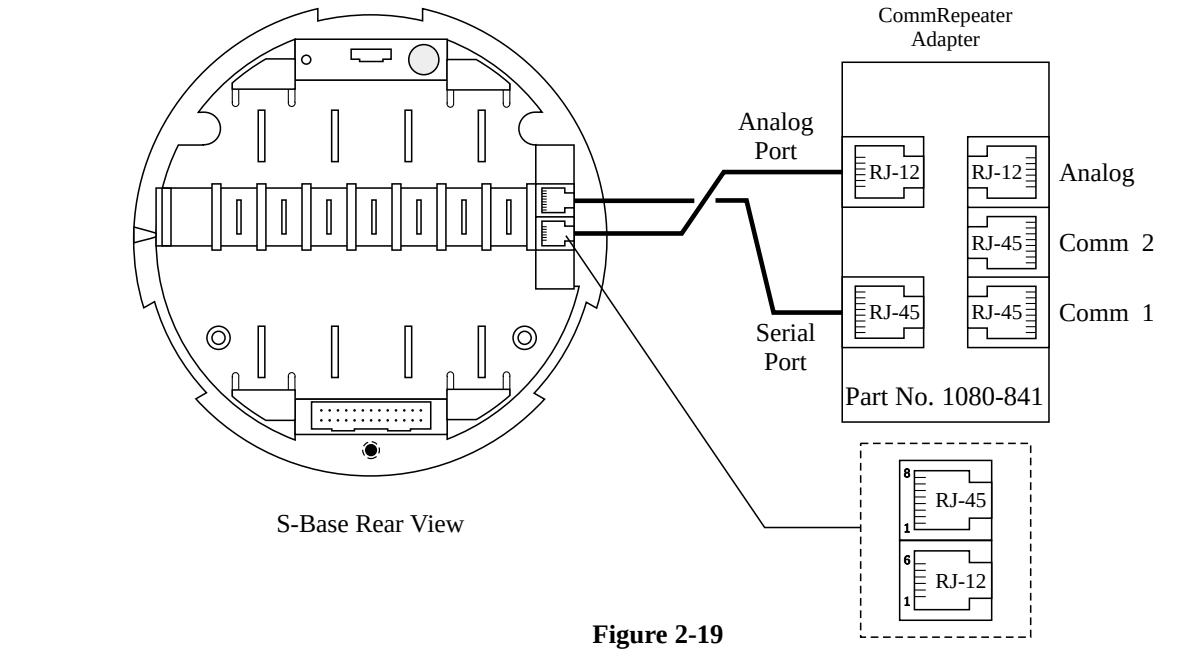


Figure 2-19

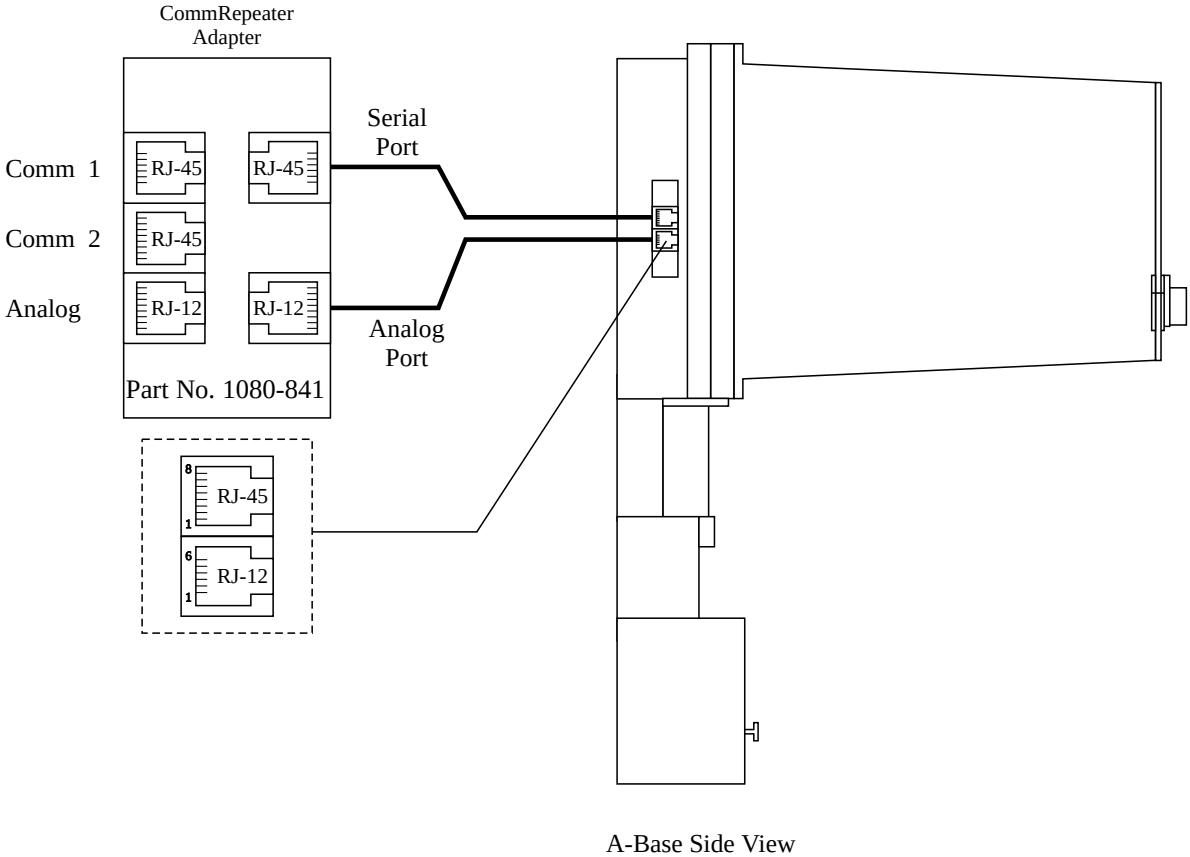


Figure 2-20

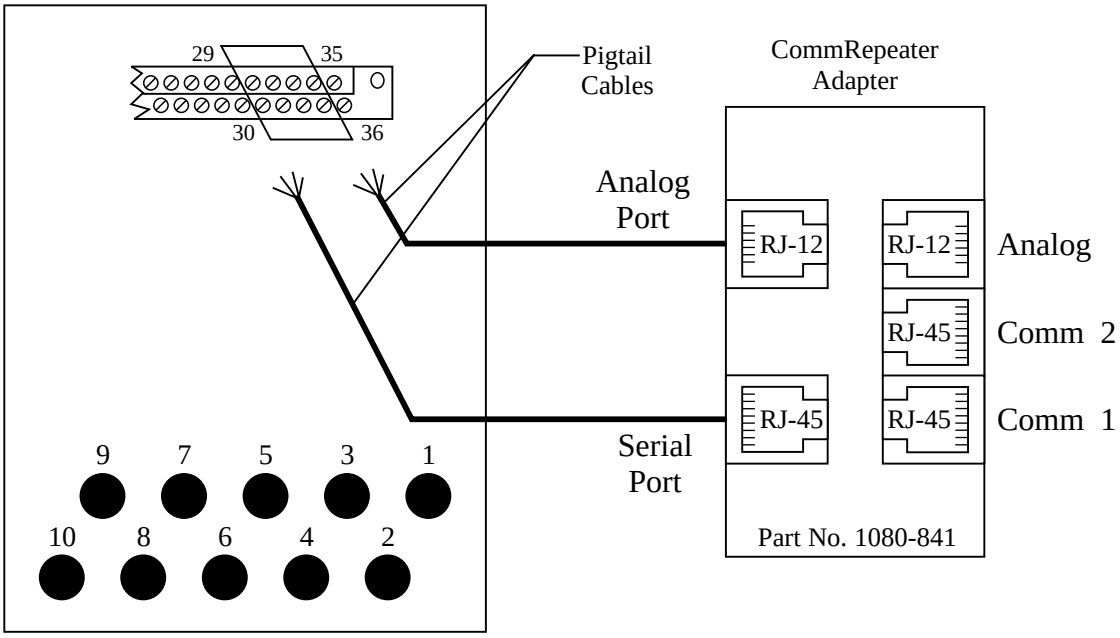

29
35
30
36
Pigtail
Cables
CommRepeater
Adapter
Analog
Port
RJ-12
RJ-12
Analog
RJ-45
Comm 2
RJ-45
RJ-45
Comm 1
Serial
Port
9
7
5
3
1
10
8
6
4
2
Part No. 1080-841
Switchboard Case Rear View

Figure 2-21

Table 2 - CommRepeater Pin-outs for A-Base and S-Base Meters at the Meter Socket Connectors

CONNECTOR	PIN NO.	RS232 REPEATER MODE	RS485 MODE	RS485 TO RS232 CONVERSION MODE
RJ-45	1	COMM2, RD-OUT	COMM2, TD/RD-B	COMM2, TD/RD-B
RJ-45	2	COMM2, TD-IN	COMM2, TD/RD-A	COMM2, TD/RD-A
RJ-45	3	COMM1, TD-OUT	COMM1, TD/RD-B	COMM1, TD-OUT
RJ-45	4	COMM1, DTR-OUT	COMM1, RTS-A	COMM1, DTR-OUT
RJ-45	5	COMM1, RTS-OUT	COMM1, RTS-B	COMM1, RTS-OUT
RJ-45	6	COMM1, RD-IN	COMM1, TD/RD-A	COMM1, RD-IN
RJ-45	7	COMM1, RS232 GND	NOT ASSIGNED	COMM1, RS232 GND
RJ-45	8	COMM2, RS232 GND	NOT ASSIGNED	NOT ASSIGNED
RJ-12	1	Analog Output, Watts	Analog Output, Watts	Analog Output, Watts
RJ-12	2	Analog Output, Reactive	Analog Output, Reactive	Analog Output, Reactive
RJ-12	3	Analog Output, Volts Squared	Analog Output, Volts Squared	Analog Output Volts Squared
RJ-12	4	Analog Output, Analog Return	Analog Output, Analog Return	Analog Output, Analog Return
RJ-12	5	COMM2, DTR-IN	COMM2, RTS-A	COMM2, RTS-A
RJ-12	6	COMM2, RTS-IN	COMM2, RTS-B	COMM2, RTS-B

Note: The RJ-45 connector is the serial port. The RJ-12 connector is the analog port.

Table 3 - CommRepeater Terminal Connections for Switchboard Case Meters

TERMINAL NUMBER	RS232 REPEATER MODE	RS485 MODE	RS485 TO RS232 CONVERSION MODE	WIRE * COLOR
23	COMM2, DTR-IN	COMM2, RTS-A	COMM2, RTS-A	Blue
24	COMM2, RTS-IN	COMM2, RTS-B	COMM2, RTS-B	Yellow
25	Analog Output, Analog Return	Analog Output, Analog Return	Analog Output, Analog Return	Green
26	Analog Output, Volts Squared	Analog Output, Volts Squared	Analog Output, Volts Squared	Red
27	Analog Output, Reactive	Analog Output, Reactive	Analog Output, Reactive	Black
28	Analog Output, Watts	Analog Output, Watts	Analog Output, Watts	White
29	COMM2, RS232 GND	NOT ASSIGNED	NOT ASSIGNED	Brown
30	COMM1, RS232 GND	NOT ASSIGNED	COMM1, RS232 GND	Blue
31	COMM1, RD-IN	COMM1, TD/RD-A	COMM1, RD-IN	Yellow
32	COMM1, RTS-OUT	COMM1, RTS-B	COMM1, RTS-OUT	Green
33	COMM1, DTR-OUT	COMM1, RTS-A	COMM1, DTR-OUT	Red
34	COMM1, TD-OUT	COMM1, TD/RD-B	COMM1, TD-OUT	Black
35	COMM2, RD-OUT	COMM2, TD/RD-A	COMM2, TD/RD-A	Orange
36	COMM2, TD-IN	COMM2, TD/RD-B	COMM2, TD/RD-B	Gray

* Wire colors shown for Terminals 23 through 28 are used on Scientific Columbus cable Part No. 15389-001.
Wire colors shown for Terminals 29 through 36 are used on Scientific Columbus cable Part No. 15387-001.

Table 4 - Connector Pin-Outs for Adapter Box

CONNECTOR	PIN NO.	RS232 REPEATER MODE	RS485 MODE	RS485 TO RS232 CONVERSION MODE
RJ-45 COMM 1	1	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
	2	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
	3	TD1_OUT	TD/RD-B	TD1_OUT
	4	DTR1_OUT	RTS-A	DTR1_OUT
	5	RTS1_OUT	RTS-B	RTS1_OUT
	6	RD1_IN	TD/RD-A	RD1_IN
	7	GND1	NOT ASSIGNED	GND1
	8	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
RJ-45 COMM 2	1	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
	2	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
	3	TD2_IN	TD/RD-B	TD/RD-B
	4	DTR2_IN	RTS-A	RTS-A
	5	RTS2_IN	RTS-B	RTS-B
	6	RD2_OUT	TD/RD-A	TD/RD-A
	7	GND2	NOT ASSIGNED	NOT ASSIGNED
	8	NOT ASSIGNED	NOT ASSIGNED	NOT ASSIGNED
RJ-12 ANALOG OUTPUT	1	Watts	Watts	Watts
	2	Reactive	Reactive	Reactive
	3	Volts Squared	Volts Squared	Volts Squared
	4	Analog Return	Analog Return	Analog Return
	5	Analog Return	Analog Return	Analog Return
	6	Analog Return	Analog Return	Analog Return

3. Meter Operation

3.1 Meter Faceplate and User Interface

Meter Faceplate

The meter's faceplate displays general information about the meter including model number, form, class, voltage, frequency, wiring configuration (3 W or 4 W), test amps, and the K_t (test pulse constant in wh/count). There is also an area for the user to write in the CTR (current transformer ratio), VTR (voltage transformer ratio), and a multiply-by field (see Figure 3-2).

User Interface/Display Buttons

There are four buttons located at the lower right of the meter's faceplate that make up the user interface or MMI (man-machine interface) of the meter.

With the meter cover or globe in place, the reset mechanism allows the user to press the DISPLAY button which will scroll through the meter's display registers. It also allows the user to perform a Demand Reset if the reset mechanism is not in the locked position.

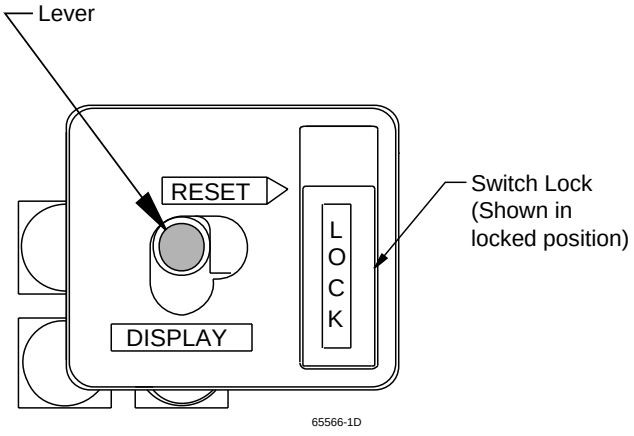


Figure 3-1
JEM10 Reset Mechanism

With the meter cover or globe removed, all four buttons are accessible to the user. This allows the meter to be placed in Set Mode by pressing the DISPLAY and SET buttons at the same time. This allows the meter's real-time clock to be set and its registers to be preset. Refer to Section 3.4 on how to set the meter time and preset the registers. Having the four buttons accessible to the user also allows the meter to be placed in Test Mode by pressing the TEST button. Refer to Section 3.4 for a description of the meter in Test Mode.

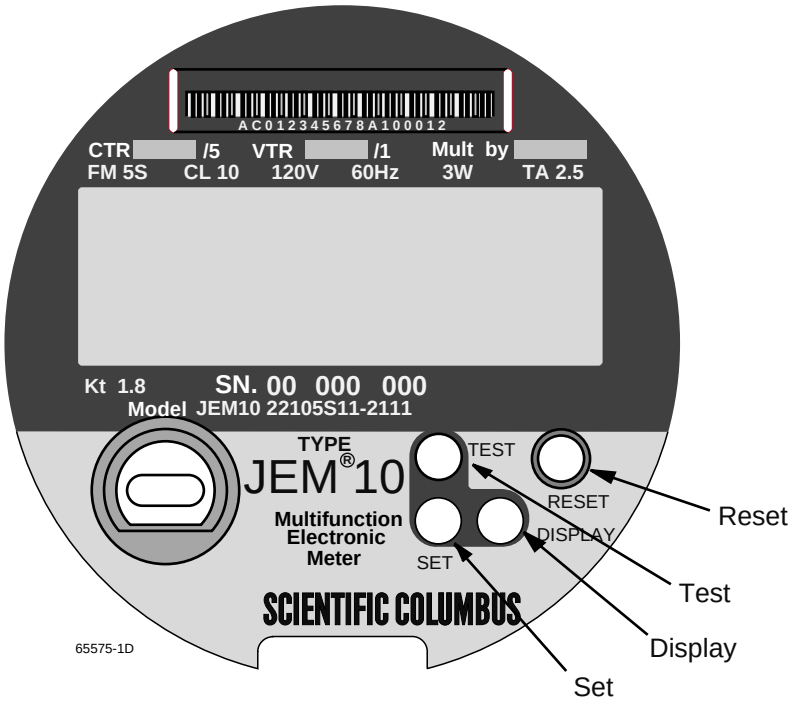


Figure 3-2
JEM10 Function Switches

3.2 Meter Display Description

The meter's display allows the user to view display registers that are programmed in the meter. The display allows the user to identify the display register by means of a User ID field (register ID), quantity name and label fields, and time-of-use rate indicators. The register value or data field can display up to six digits with up to three decimal-point locations. A mode indicator section of the display determines if the meter is in either Normal, Alternate, Set, or Test Mode. Potential indicators illustrate the presence or absence of phase voltages. Direction and load-rate indicators determine the direction of power flow for both real (W) and reactive (R) power.

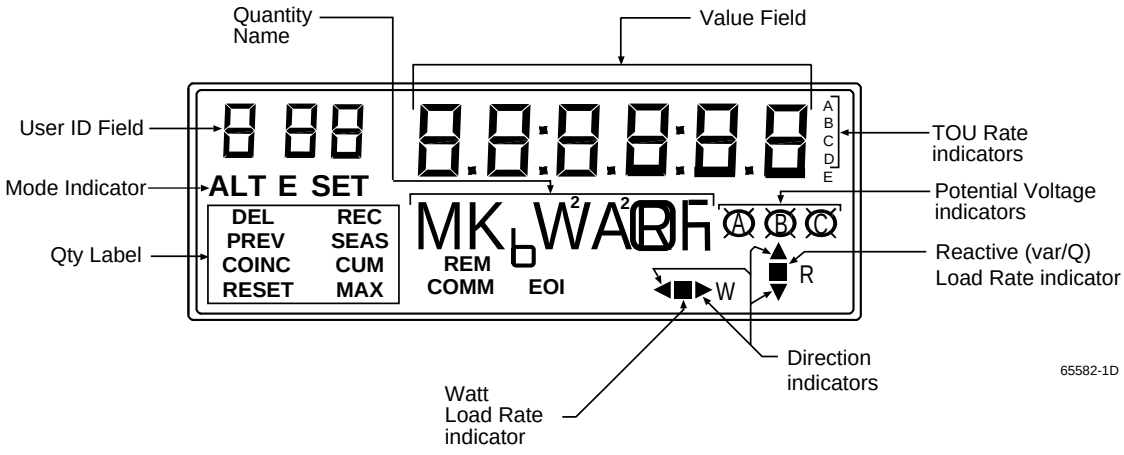


Figure 3-3
JEM10 LCD Explanation

Display Labels

User ID Field—A user-definable, numeric field to identify register.

Mode indicator—Indicates present display mode of the meter: Alternate-Register Mode, Test Mode, Normal Mode, or Set Mode.

Quantity Label—Provides descriptive information about the present meter quantity reading.

Direction indicator—Indicates watt and reactive quantity direction.

Watt Load-Rate indicator—Flashes at a rate proportional to the present load. It's updated at the meter's display rate and should not be used for timed test.

Reactive Load-Rate indicator—Flashes at a rate proportional to the present reactive load. It's updated at the meter's display rate and should not be used for timed test.

Potential Voltage indicators—Indicate voltage applied for each of the three phases.

TOU Rate indicator—Specifies the time-of-use rate in effect: A, B, C, or D. (E is unused.)

Value Field—Displays the current register value for the selected register.

Quantity Name—Specifies units presently displayed.

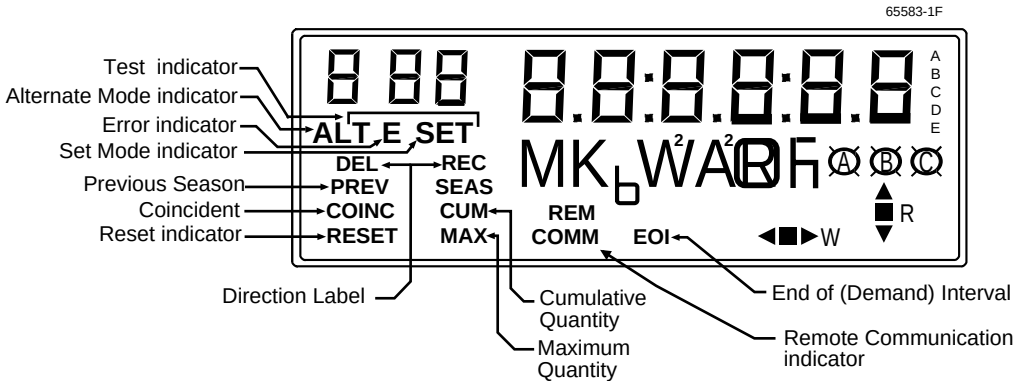


Figure 3-4
JEM10 Display Annunciators

Display Annunciators

TEST—Indicates that the meter is in Test Mode.

ALT—Signifies that the meter is in the Alternate-Register Display Mode.

E—Indicates error condition. (See Section 5.4 on Health Diagnostics.)

SET—Indicates that the meter is in the Set Mode, used for presetting registers and setting the date and time. This will also illuminate in sequence with TEST in Calibration Mode.

PREV—Register label signifies that the past month's storage registers are currently displayed.

PREV SEAS—Indicates data from previous TOU seasons.

COINC—Register label indicates that the register displayed occurred at the time of a specified maximum demand.

RESET—This flashes after the RESET button is pressed. It indicates that all maximum-demand registers, coincident-demand registers, power-factor registers, and times of maximum demands have been cleared. It updates the cumulative-demand register and transfers active readings to the storage registers. The reset function is subject to a configurable-reset lockout.

REC—Indicates quantity received (reverse direction).

DEL—Indicates quantity delivered (forward direction).

MAX—Illuminates when the display is a maximum-demand quantity.

CUM—Indicates that a cumulative quantity is displayed.

REM COMM—Indicates communications are being performed through the meter's COMM option. Communications through the optical port are not possible if this is illuminated.

EOI—Briefly flashes at the end of each demand interval.

3.3 Register Initialization

To clear all register data, a register initialization must be performed. This procedure does not erase any of the configuration parameters or load-profile data. This may be done when a meter is first put in service.

To access the switches needed to perform an initialization, the globe of the S-base or A-base meter, or the front panel of the switchboard-case meter, must be removed.

To perform a register initialization:

➔ To perform an initialization on the meter, simultaneously hold down the DISPLAY, SET, and TEST switches with power already applied to the meter.

➔ After initializing the meter, replace and seal the globe or front panel of the meter.

Cold Start

If JEM10 boards have been replaced or meter firmware has been upgraded, a cold start procedure must be performed. A cold start erases all register, load profile, and configuration data. The communication parameters are set to defaults. The meter will display a Normal-Mode segment test indicating that a cold start has occurred. A default configuration is loaded into the meter after a cold start. It is advisable to configure the meter using JEMSET configuration software to set the meter for the specific application.

To perform a cold start:

➔ To perform a cold start, simultaneously hold down the DISPLAY, SET, and TEST switches while applying power to the meter.

The default communication parameters are:
Optical port baud rate = 9600
Optical port address = 02
Comm option baud rate = 1200
Comm option address = 01
High-level Password = 000000
Low-level Password = 000000

Warning!
Performing a register init or cold start will cause loss of data.

3.4 Register Display Modes

The JEM10 can display a large number of display registers. The registers can be grouped in different display modes including Normal, Alternate, and Test. Normal Mode is the "normal" display mode of the meter. If Scroll Mode is enabled, the Normal Mode registers are scrolled through at a user-configureable rate. Up to 50 registers can be displayed in Normal Mode.

Alternate Mode registers allow access to registers that are not displayed in the Normal Mode. These registers are not directly accessible to the meter reader and are a convenient register group to display storage registers. Up to 50 registers can be displayed in Alternate Mode.

Test Mode is used for testing the accuracy of the meter. Refer to Chapter 4.0 Test & Calibration for a complete explanation of Test Mode.

Note: When in Test Mode, only the Test Mode registers update. The standard metering registers and load-profile data do not accumulate. The normal metering functions are suspended until Test Mode is exited.

Note: Refer to Appendix A for a default register configuration.

To manually scroll through Normal Mode registers:

➔ The display registers defined in the Normal Mode can be manually scrolled by pressing the DISPLAY button or by pressing down on the reset mechanism.

To enter Alternate Mode displays:

➔ Alternate Mode is entered by holding down the DISPLAY button or holding down the reset mechanism for two or more seconds. Release the button or the reset mechanism as soon as ALT is displayed on the meter's display.

➔ The Alternate Mode registers can be scrolled through manually by pressing the DISPLAY button or by pressing down on the reset mechanism.

➔ At the end of the Alternate Mode register list, the meter will return to Normal Mode. Pressing the DISPLAY button or holding down the reset mechanism for two or more seconds while in Alternate Mode will also return the meter to Normal Mode.

To enter Test Mode:

➔ Remove the meter globe or front panel.

➔ Press the TEST button to enter Test Mode. The meter display will indicate the meter is in Test Mode.

➔ To step through the Test Mode registers, press the DISPLAY button.

➔ Exit Test Mode by pressing the TEST button. If Test Mode is not exited by the user, the Test Mode timeout will return the meter to Normal Mode in a programmable number of minutes as set with JEMSET.

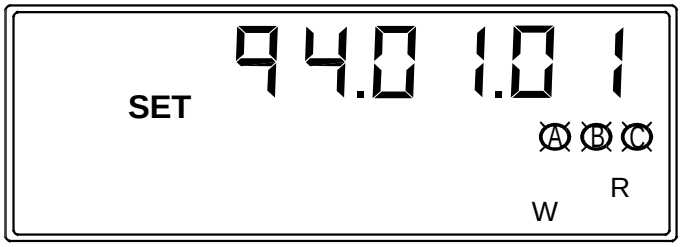
3.5 Setting the Date, Time, and Presetting Register

The date and time on the JEM10 meter can be set either through the MMI or through serial communications (through the JEMSET software).

■ Date Set

➔ **To set the date on the meter:**

1. Remove the meter globe or front panel.
2. To enter the Date Set Mode, press the SET and DISPLAY buttons. The date appears as YY.MM.DD. The first digit in the line blinks. (Blinking digits are *selected* digits.)



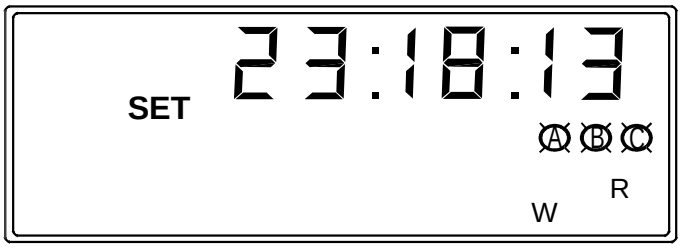
65584-1B

3. To increment the blinking digit, press the SET button.
4. To record this value and select the next digit, press the DISPLAY button.
5. Continue selecting and incrementing digits until the desired date has been configured.
6. When the last digit has been changed, press the SET and DISPLAY buttons. The meter automatically enters the Time Set Mode.

■ Time Set

➔ **To change the time in the Time Set Mode (Figure 3-5):**

1. Remove the globe or meter front panel.
2. Enter the Time Set Mode from the Date Set Mode. Simultaneously hold down the SET and DISPLAY buttons to enter the Date Set Mode. After necessary changes are made in the Date Set Mode (if any), simultaneously hold down the SET and DISPLAY buttons a second time to enter the Time Set Mode.
3. The time appears as HH.MM.SS. The blinking digit is the selected digit.



65585-1B

4. To increment the selected digit, press the SET button.
5. To store this value and advance to the next digit, press the DISPLAY button.
6. When changes are complete, press the SET and DISPLAY buttons to exit the Time Set Mode. The meter automatically enters the Register Preset Mode (if so configured). Otherwise, it returns to the Manual Display Mode.

Note: To abort the date and time set before changes are made, press the TEST and DISPLAY buttons. Press the TEST and DISPLAY buttons to clear changes and restart the process, or press the TEST and DISPLAY buttons a second time to abort the Date Set/Time Set Mode.

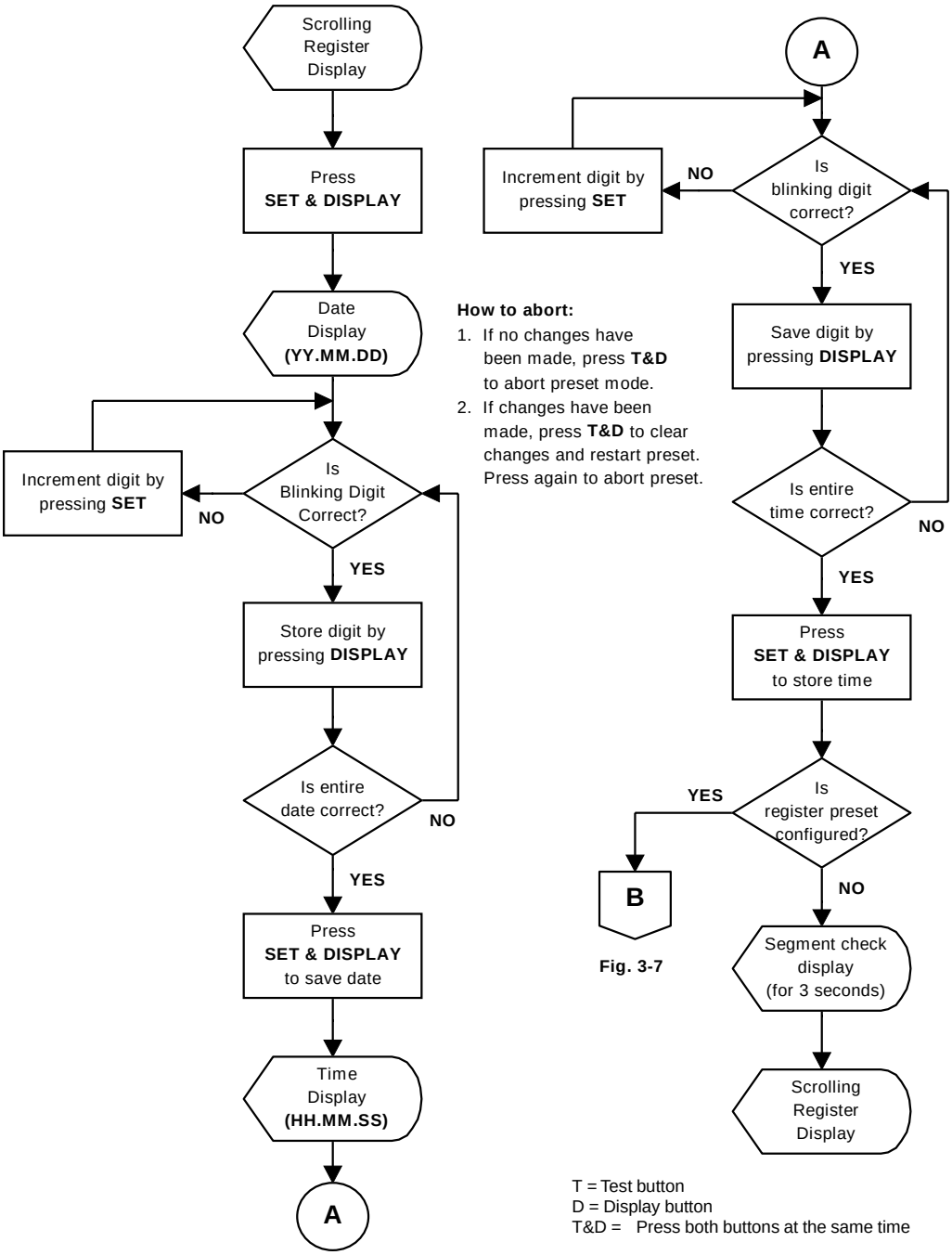


Fig. 3-7

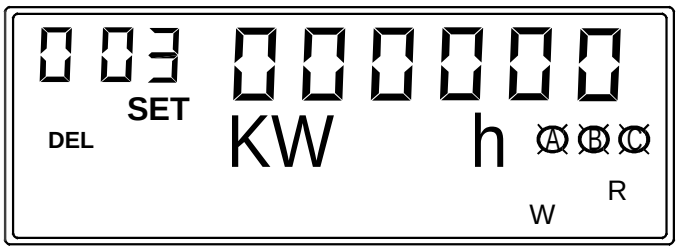
Figure 3-5
Date and Time Set Function Flowchart

■ Register Preset

The Register Preset option enables the user to set meter registers at a predetermined value for billing purposes. This option is often used when meters are replaced, allowing the user to set the new meter with the previous meter's register settings. Register presets are available only if the configuration option is enabled in the meter. Only consumption registers are available for preset (Figure 3-6). The actual JEM10 register value is nine digits long. A manual register can only preset the six digits displayed.

➔ **To preset the meter registers:**

1. Enter the Register Preset Mode from the Time Set Mode by simultaneously holding down the SET and DISPLAY buttons. The first consumption register available for presetting appears on the meter display.



65586-1C

2. The first blinking digit is the selected digit. To increment that digit, press the SET button. To store this value and select the next digit in the sequence, press the DISPLAY button.
3. When the desired register value is reached, save that register value by pressing the SET and DISPLAY buttons. The meter scrolls to the next consumption register.
4. If no other registers are to be changed, store all presets by pressing the TEST and SET buttons. The meter scrolls in the Normal Display Mode.
5. To preset registers in the Alternate Display Mode, hold down the DISPLAY button for two or more seconds and follow the same sequence as outlined above. When complete, hold down the DISPLAY button again for two or more seconds to exit the Alternate Display Mode.

Note: To abort the Register Preset Mode before changes are made, press the TEST and DISPLAY buttons. To clear changes made in Preset Mode, press the TEST and DIPLAY buttons. To exit the Register Preset Mode without saving changes, press the TEST and DISPLAY buttons a second time.

Fig 3-6

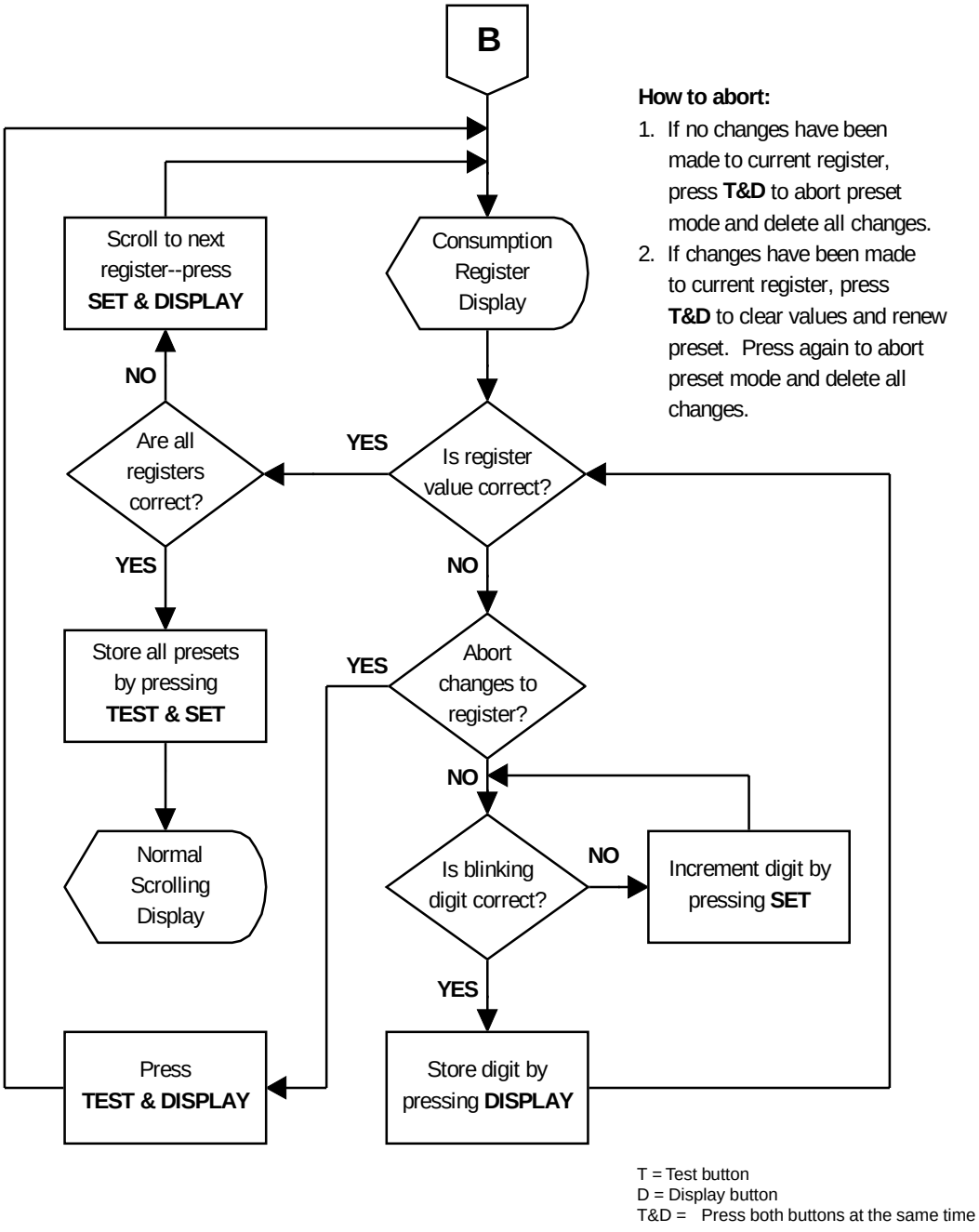

B
How to abort:
1. If no changes have been made to current register, press T&D to abort preset mode and delete all changes.
2. If changes have been made to current register, press T&D to clear values and renew preset. Press again to abort preset mode and delete all changes.
Scroll to next register--press SET & DISPLAY
Consumption Register Display
NO
Are all registers correct?
YES
Is register value correct?
YES
NO
Store all presets by pressing TEST & SET
YES
Abort changes to register?
NO
Normal Scrolling Display
Is blinking digit correct?
NO
Increment digit by pressing SET
YES
Press TEST & DISPLAY
Store digit by pressing DISPLAY
T = Test button
D = Display button
T&D = Press both buttons at the same time

Figure 3-6
Consumption Register Preset Flowchart

3.6 Analog Output Option

The meter transmits analog-output signals from the analog-output option board. Three current-output signals can be supplied for external indication or to interface to other data systems. Each analog output is proportional to one of the basic measured quantities: watt, var (or Q), and volt squared. The bidirectional signals are 2.4 mAdc at full-scale polyphase watts, vars, and Qs. For volts squared, the signal is 1.2 mAdc at nominal voltage input.

The analog-output port is a six-pin modular jack located next to the communication-option port at the base of the meter on socket and A-base meters. The analog-output signals for switchboard-case meters are available through the 40-pin screw terminal connector at the rear of the case.

3.7 KYZ Pulse Output Option

The meter may have a KYZ pulse-output option (as determined by the model number). The JEM10 can have up to five Form-C (three-wire) pulse-output channels: ±watthours, ±varhours (or Q-hours), and V^2h. Each channel will count at the rate specified by its programmed K_e value. This is done through the JEMSET software.

3.8 Alarm and Status Outputs

The JEM10 meter has one programmable alarm/status Form-A (two-wire) output. It can be set to close at the end of each demand interval or when a demand threshold is exceeded, or when a phase potential is lost. There is a fixed five minute lockout for the Alarm and Status Outputs after a loss of power or a meter re-configuration. The JEM10 meter will not monitor these outputs until five minutes after a power outage or a meter re-configuration.

An end-of-demand-interval output closes the contact for one second at the end of each interval closure.

For demand threshold, the register monitored and threshold value must be programmed into the meter with the JEMSET software. A fixed five percent hysteresis value is applied to the measurement to prevent output chatter. When a demand threshold is reached, the contact will close. The contact remains closed until the load drops five percent below the threshold level. For example, a demand threshold that exceeds 500 kW will not turn off until it drops below 475 kW.

For potential loss, any loss of any expected phase will cause the contact to open (i.e. Phase A and C for two-element meters and Phases A, B, and C for three-element meters). The contact will also open if auxiliary power is lost.

3.9 Load Profile

The JEM10 meter is capable of storing up to five channels of load-profile data depending upon the model number. The charts below represent the amount of days of storage based upon the number of channels and interval length. The top chart represents the total amount of load-profile storage as read by MV-90; the bottom chart represents the total amount of load-profile storage as ready by JAV. JAV is limited on the amount of load-profile data that it can retrieve. A load-profile response size which only affects JAV load-profile retrieval can be set within JEMSET. Refer to Section 6.4 for load-profile theory of operation.

	Number of Channels				
Interval Length (minutes)	1	2	3	4	5
1	24	12	8	6	4
2	48	24	16	12	9
3	72	36	24	18	14
4	95	48	32	24	19
5	119	60	40	30	24
6	142	71	48	36	28
10	235	118	79	59	47
12	280	142	95	71	57
15	347	176	118	89	70
20	456	233	157	118	94
30	665	344	231	174	140
60	1225	652	444	337	270

Maximum Number of Days of Load-Profile Storage Retrieved with MV-90

	Number of Channels				
Interval Length (minutes)	1	2	3	4	5
1	13	6	4	3	2
2	26	13	8	6	5
3	39	19	13	9	7
4	51	26	17	13	10
5	64	32	21	16	13
6	77	38	26	19	15
10	127	64	43	32	25
12	152	77	51	38	31
15	188	95	64	48	38
20	247	126	84	63	51
30	360	186	125	94	76
60	664	353	240	182	147

Maximum Number of Days of Load-Profile Storage Retrieved with JAV
(38K Load-Profile Response Size)

3.10 Serial Communication

The JEM10 meter supports Scientific Columbus' binary protocol. The communications are a command-oriented protocol sent at no parity, eight data bits, and one stop bit. The JEM10 comes with an optical port on the front of the meter, and an optional communications port that can be either RS-232, 20 mA, or internal modem.

Optical Port Communications

The optical port located on the meter face supports all serial communication with JEM10. A test pulse (called the K_t) is available at the optical port when the meter is in Test Mode.

The optical port operates from the optical transmitter and receiver mounted on the meter display board. The optical signal is passed through a lens on the meter cover. The lens has a round connection/alignment guide with a flat side to assure proper orientation of an optical probe. It is compatible with other similar connectors in the industry. The optical port baud rate may be set to 300, 1200, 2400, or 9600 baud (9600 is default). The Model 5282 optical port adapter converts optical signals (both test-output pulses and serial communications) to RS-232 and dry-contact closure signals.

Serial Communications Option

- **RS-232**

  The RS-232 communication option provides an active serial interface which operates up to 9600 baud. The RS-232 option is compatible with Electronic Industries Association RS-232 electrical specifications. When installed, this option provides RS-232 communications through the communications port on the JEM10 with an eight-pin modular connector.

  The baud rate is programmable (300, 1200, 2400, or 9600 baud) and is configured with the JEMSET configuration software.

- **20 mA**

  The 20 mA current-loop option provides a passive serial interface (current is supplied by another source) which operates up to 9600 baud. When installed, this option provides 20 mA current-loop communications through the communications port of the JEM10 meter. This option consists of a 20 mA communication option board with built-in surge protection and isolation.

  Specifications

  V_{SAT} Transmitter Output = 2.7 Vdc (maximum) @ I_C = 20 mA
  V_{ON} Receiver Input = 2.75 Vdc (maximum) @ I_{IN} = 20 mA
  V_{OC} Maximum open circuit voltage compliance of current source = 27 Vdc

The baud rate is programmable (300, 1200, 2400, or 9600 baud) and can be set with the JEMSET configuration software program. Twisted-pair or shielded-twisted-pair wire is recommended for 20 mA loop hookup.

- **Internal Modem Option**

Answer Modem

The JEM10 internal modem can be programmed to determine the number of rings required before answering. An answer window which restricts the modem to answer only during certain times of the day is also programmable. The modem will connect at any baud rate lower than the maximum 9600 baud.

The modem supports off-hook-detect in both Answer and Call-Originate Modes based on the position of jumper JP3, located on the modem board. With the jumper removed, off-hook-detect is enabled. This will cause the JEM10 to drop the line of a data call if a local phone receiver goes off-hook. The operation of this is dependent upon the ringer equivalence of the phone sharing the line with the JEM10. The phone should have a ringer equivalence of 1.0 A.

Phone-Home Modem

The JEM10 internal modem has the capability of performing call-originate (phone-home) calls. The meter can be programmed to call-originate as a result of certain events including: meter auxillary power restoration, low battery, demand threshold, phase loss, phase restoration, health check, and on a scheduled call-in for data retrieval (as supported by MV-90). Each event can be set to call up to four different phone numbers. Each phone number has a phone number type assigned to determine how the meter should respond to the phone number. Each phone number can be assigned a “Standard” or “Verbose” setting.

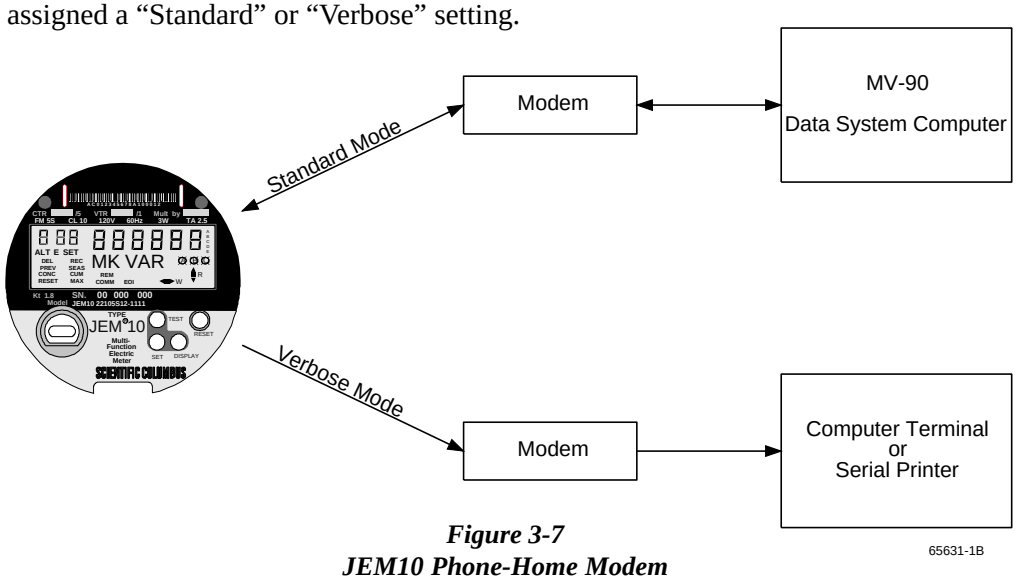


Figure 3-7
JEM10 Phone-Home Modem

The Standard operation is used when calling in to a computer-retrieval system such as MV-90 that is set up to receive incoming meter phone calls. The JEM10 communicates data required by MV-90 to establish an MV-90 session.

The Verbose operation can call the phone number and report the information without requiring any special processing software. Once the meter establishes communications, it will send across an ASCII response indicating the meter name and location, the time of call, and which events occurred. This can be logged either by a computer running terminal-emulation software or by a serial printer connected to the modem. Below is a sample printout of two call-originate messages from a JEM10 meter that lost Phase A potential for 15 minutes.

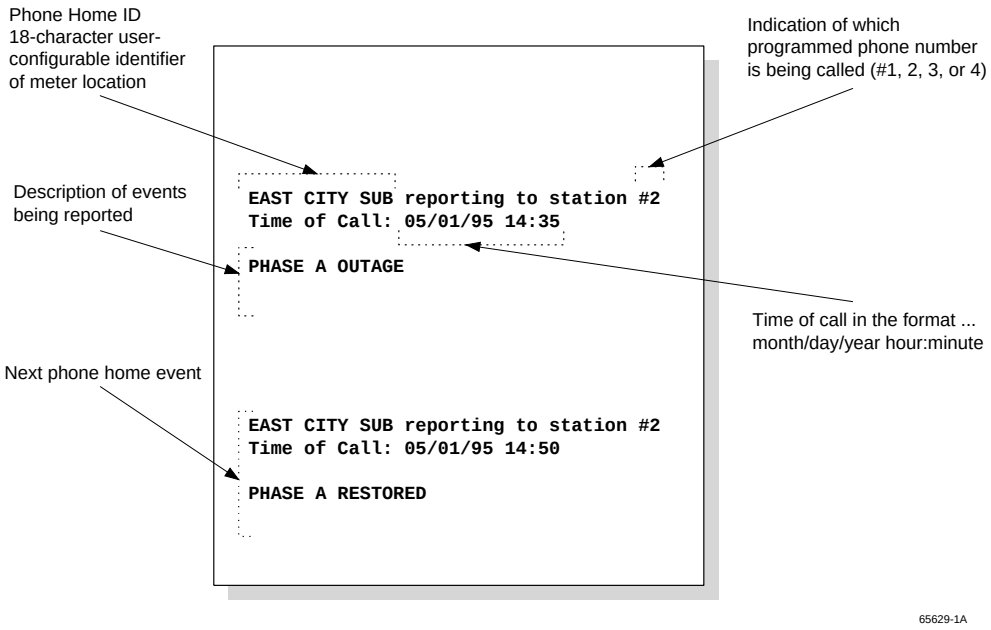

Phone Home ID
18-character user-configurable identifier of meter location
Indication of which programmed phone number is being called (#1, 2, 3, or 4)
Description of events being reported
EAST CITY SUB reporting to station #2
Time of Call: 05/01/95 14:35
PHASE A OUTAGE
Time of call in the format ... month/day/year hour:minute
Next phone home event
EAST CITY SUB reporting to station #2
Time of Call: 05/01/95 14:50
PHASE A RESTORED
65629-1A

Figure 3-8
Sample Printout of a Verbose Mode Phone-Home Session

The internal modem supports a retry scheme that will prevent the modem from making unneccesary phone calls. A description and how to define the retry scheme are included in the JEMSET Instruction Manual.

All of these capabilities can be performed at any baud rate up to 9600 baud. The phone-home modem will also select an appropriate data rate up to 9600 baud.

FCC Compliance of the Internal Modem

This equipment complies with Part 68 of the FCC rules governing communications devices. On the outside of the meter is a label that contains the FCC registration number and Ringer Equivalence Number (REN) for this equipment. This information must be provided to the telephone company, if requested.

This equipment should be connected to a USO CRJ11C service jack.

The REN is used to determine the quantity of devices which may be connected to a telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most cases, the sum of the REN's should not exceed five. To be certain of the number of devices that may be connected to your specific line (as determined by the number of REN's), contact your local telephone company.

If the modem causes harm to the telephone network, the telephone company will notify you as soon as possible. Also, you will be advised of your right to file a complaint with the FCC, should this be necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice for you to make the necessary modifications so that your service is not interrupted.

If trouble is experienced with this modem, please contact Scientific Columbus for repair and warranty information. If the trouble is affecting the telephone network, the telephone company may request that you remove the equipment from the network until the problem is resolved. The customer should not attempt to repair this equipment.

The modem cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to tariffs. Contact your state public utility commission, public service commission, or corporation commission for information.

3.11 CommRepeater Communications Option

Introduction

The JEM10 CommRepeater Option provides enhanced communications capabilities for the JEM10 meter. By providing two communications ports, this option makes it possible to connect several meters to one common communications channel. The JEM10 CommRepeater can be configured to operate as an RS232 Repeater, an RS485 Transceiver, or an RS232 to RS485 Convertor. The CommRepeater Option is also required when using DNP 3.0 Communications Protocol Firmware. Refer to the JEM10 DNP Device Profile Document 1081-132 for further information on this protocol.

Multiple meter connectivity is obtained through two communications ports: COMM 1 and COMM 2. Both communications ports are equipped with RJ-45 modular 8-pin connectors. The CommRepeater Option supports the JEM10 query-response type of communications, where the querying station is the communications master and the JEM10 meter is the communications slave. The JEM10 CommRepeater is not fully bi-directional; COMM 1 must be connected to the master side of the communications channel, and COMM 2 must be connected to the slave side of the communications channel. The JEM10 CommRepeater does not support dual-master or peer-to-peer communications.

Operating Modes

■ RS232 Repeater Mode

In the RS232 Repeater Mode, the JEM10 CommRepeater receives data from the COMM 1 port and transmits out of COMM 2. All meters share common Received Data (RD), Transmitted Data (TD), Ready-to-Send (RTS), Data-Terminal-Ready (DTR) and RS232 Ground (GND) signals. Each signal is received by the JEM10 CommRepeater, amplified and re-transmitted in the appropriate direction. A typical RS232 repeater circuit is shown in Figure 3-9.

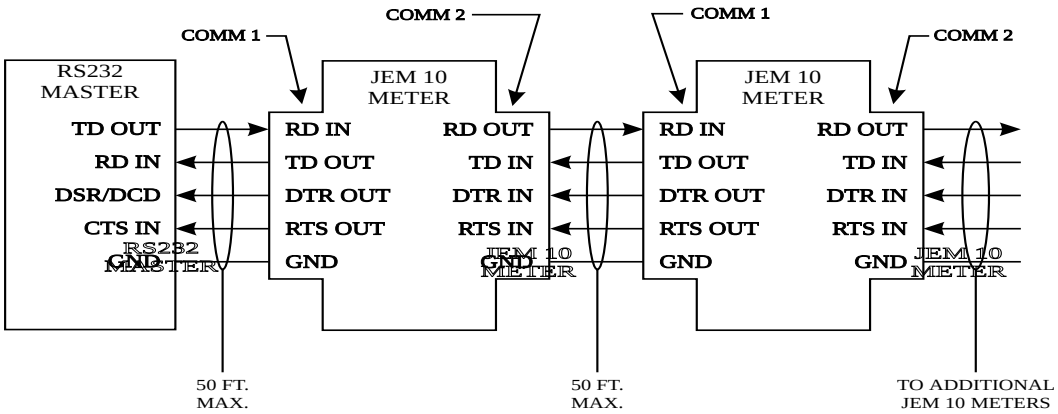


Figure 3-9
Typical RS-232 Repeater Circuit

The local meter (the meter where the CommRepeater Board is mounted) receives all data from the master through the RD IN signal of COMM 1. It is important to note that the local meter does not monitor the activity of the shared TD, RTS or DTR signals incoming from COMM 2. Those signals are amplified and re-transmitted to the master through COMM 1.

■ RS485 Mode

The RS485 protocol permits up to 32 transceiver pairs to share a party line. Because RS485 communications are differential, much longer cable lengths are possible. A typical RS485 network is shown in Figure 3-10. A twisted pair of wires can connect up to 32 drivers and receivers for half-duplex communications. There are no restrictions on where the meters are connected to the wires, and it is not necessary to have the meters connected at the ends. However, the wires must be terminated at each end with a 120 ohm resistor.
The optional shield around the twisted pair helps reduce unwanted noise, and is connected to GND at one end. The total length of the twisted pair must not exceed 4000 feet.

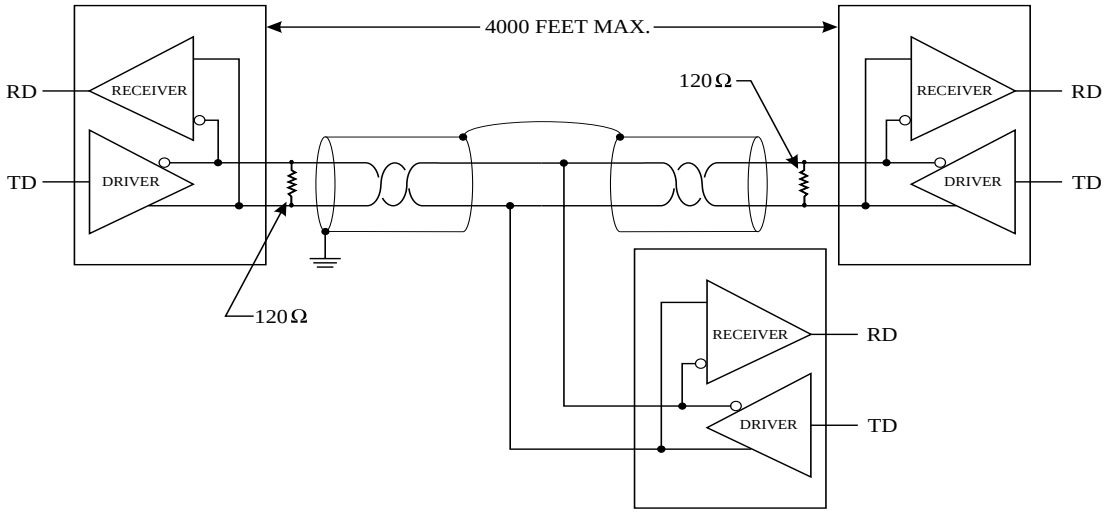


Figure 3-10
Typical RS-485 Communications Network

Fig. 3-11 shows the JEM10 CommRepeater integrated in an RS485 network. When the JEM10 CommRepeater is set up in RS485 mode, the connections to COMM1 and COMM2 are in parallel. The twisted pairs can be connected directly to COMM1 and COMM2 without using additional junction blocks.

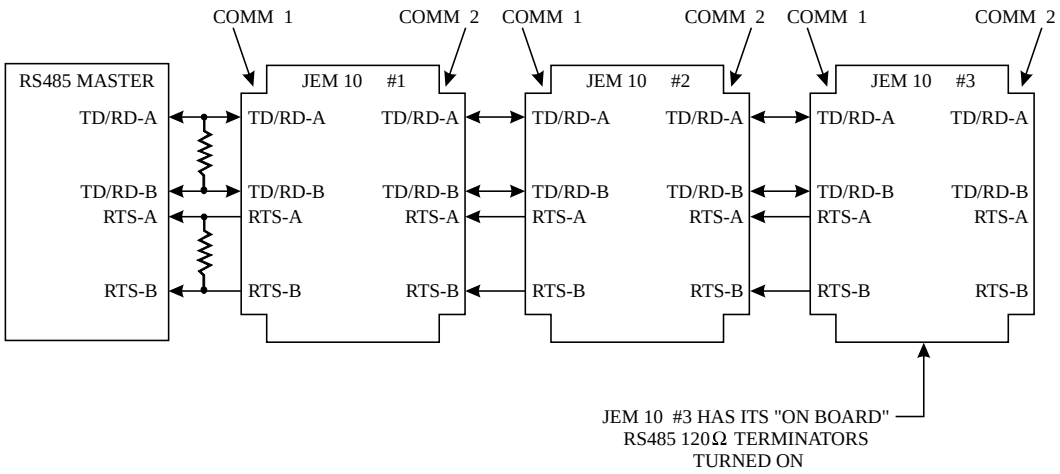


Figure 3-11
Typical JEM10 CommRepeaters in RS-485 Mode

The signals labeled “TD/RD-A” and “TD/RD-B” are a half-duplex pair that carry Received Data to the meter and Transmitted Data to the master. The “RTS-A” and “RTS-B” signals are an RS485-equivalent of the RTS control signal used in RS232 applications. The RTS control signal is unidirectional from the meters to the master. The DTR control signal is not supported in this mode.

Fig. 3-11 shows that the master end of the RS485 network must be terminated. The JEM10 CommRepeater board comes equipped with an internal terminator that may be switched on if a JEM10 CommRepeater is the last device on the network. Use of the internal terminators is necessary for proper operation. The internal terminators not only provide the necessary high frequency termination, but they also provide fail-safe biasing to keep the network in a known digital state when all of the RS485 transceivers are in the receive mode.

■ RS232 to RS485 Conversion Mode

Fig. 3-12 shows a typical RS232 to RS485 Conversion Mode application. RS232 master signals received at RD-IN are converted to RS485 protocol and sent out over the TD/RD-A and TD/RD-B pair. RS485 meter signals received at TD/RD-A and TD/RD-B are converted to RS232 protocol and sent to the master over the TD-OUT signal. RS485 meter signals received at the RTS-A and RTS-B pair are converted to RS232 protocol and sent to the master over the RTS-OUT signal. Meters configured in RS485 mode cannot send DTR signals back to the master. The local meter, however can send DTR signals back to the master.

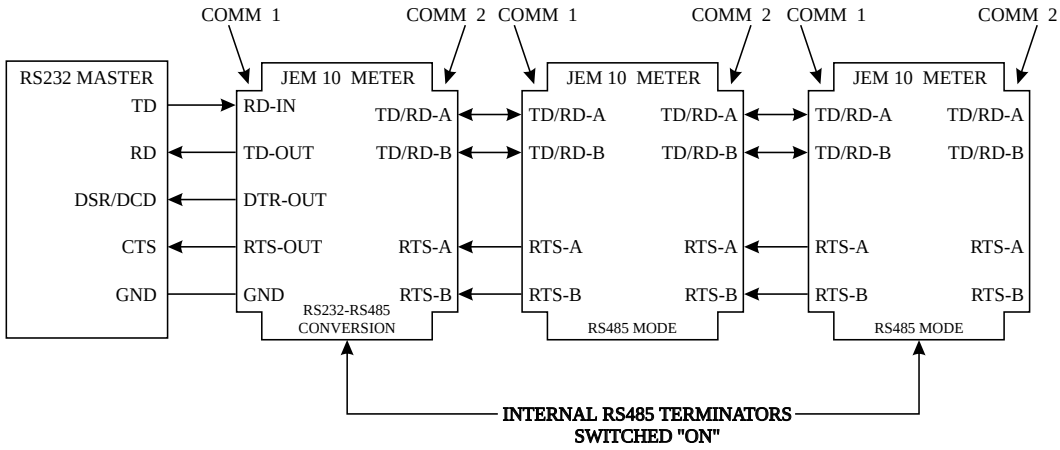


Figure 3-12
Typical RS-232 to RS-485 Conversion Mode Connections

CommRepeater Specifications

Baud Rates: Up to 9600 baud.

RS232: Tx, Rx, GND, RTS and DTR signals supported.

RS485: Tx, Rx, and RTS signals supported.

3.12 Meter Configuration

All of the parameters that determine the meter's operation can be set by using the JEMSET configuration software. JEMSET includes a file-management system for storing configurations, configuration-editing screens for setting the various parameters, and communications to program the meter or read the configuration from the meter. It also provides the ability to set and read the time on the meter through serial communications. The JEMSET Instruction Manual describes each parameter that can be programmed.

4. Test & Calibration

4.1 Overview

The JEM10 meter can be tested in the Normal Operating Mode or in the Test Mode. In the Test Mode, test pulses are output from the optical-port infrared LED. The port is not available for normal communication during this time.

4.2 Optical Port/KYZ Meter Test

The JEM10 optical port on the face of the meter performs two functions. During Standard Meter Mode, it is used for serial communications. In Test Mode, the optical port on the face of the meter sends out test pulses consistent with the test register that is being displayed (e.g. watthour, varhour, V^2hour). The KYZ pulse outputs are available even when the meter is in Test Mode, operating at their programmed K_e value. The Scientific Columbus Model 5282 Optical Port Adapter or the Scientific Columbus Model 6636 Infrared Pickup Device converts the optical pulses to contact closures. This can be interfaced to the MicroJoule®II's external gate input.

The JEM10 is tested like any other electronic meter. It should be set up so the test standard sees the same voltage and current as the meter. This is done by connecting the JEM10 voltage elements in parallel and the current elements in series. Figure 4-1 shows an example of how to connect a JEM10 and a MicroJoule II to an external load source.

JEM10 Test Pulse Output in Test Mode

It is important to wait 15 seconds after application of potential before entering Test Mode. Otherwise, the meter may not produce test pulses in Test Mode. If the meter is suspected of not producing test pulses, scroll through Test Mode to the function under test (after 15 seconds of power-on time).

Modern computer-controlled test systems are susceptible to this effect because potential is often removed and then restored between test procedures. Each time the meter is powered down and re-energized, Test Mode should be re-entered after the 15-second delay.

4.3 Testing the JEM10 Meter with the MicroJoule II

With a MicroJoule II, the user can test the meter with either the KYZ test pulse or the optical test pulse (with Optical Port Adapter Model 5282). The MicroJoule II includes the counting functions for a multiple-pulse test (Figure 4-1).

The JEM10 may be tested with good readability using one or more test pulses. Resolution is determined by the standard used. The test-connection diagram for MicroJoule II shows the electrical connections to a Form 5A meter given that connections to a meter are standard for the industry according to the form, class, and voltage. Currents are wired in series with MicroJoule current connections and all voltages are wired in parallel.

Note: To use test pulses from the optical port, the meter must be in the Test Mode.

The following parameters need to be programmed in the MicroJoule II:

- In the K_h field, enter the K_t* of the JEM10 meter as printed on the meter faceplate if using the JEM10 optical port in Test Mode. If testing one of the KYZ channels, take the secondary pulse value (as programmed in JEMSET) and multiply it by two (since only half of the contact is used).

- Enter the proper voltage, current, and number of elements.

- Ensure the standard parameters, such as MA, number of test counts, etc., are properly set.

Once the JEM10 is set up in the MicroJoule II, a test can be run. As a good rule, the test should have at least 10,000 counts from the standard. Refer to the MicroJoule II Instruction Manual on specific testing instructions.

*For the Volts Squared Hour (V^2H) function:

$$K_t = \frac{(\text{nominal voltage rating of meter})^2}{1000}$$

V^2H *Example for 120V meter*

$$K_t = \frac{(120)^2}{1000} = 14.4$$

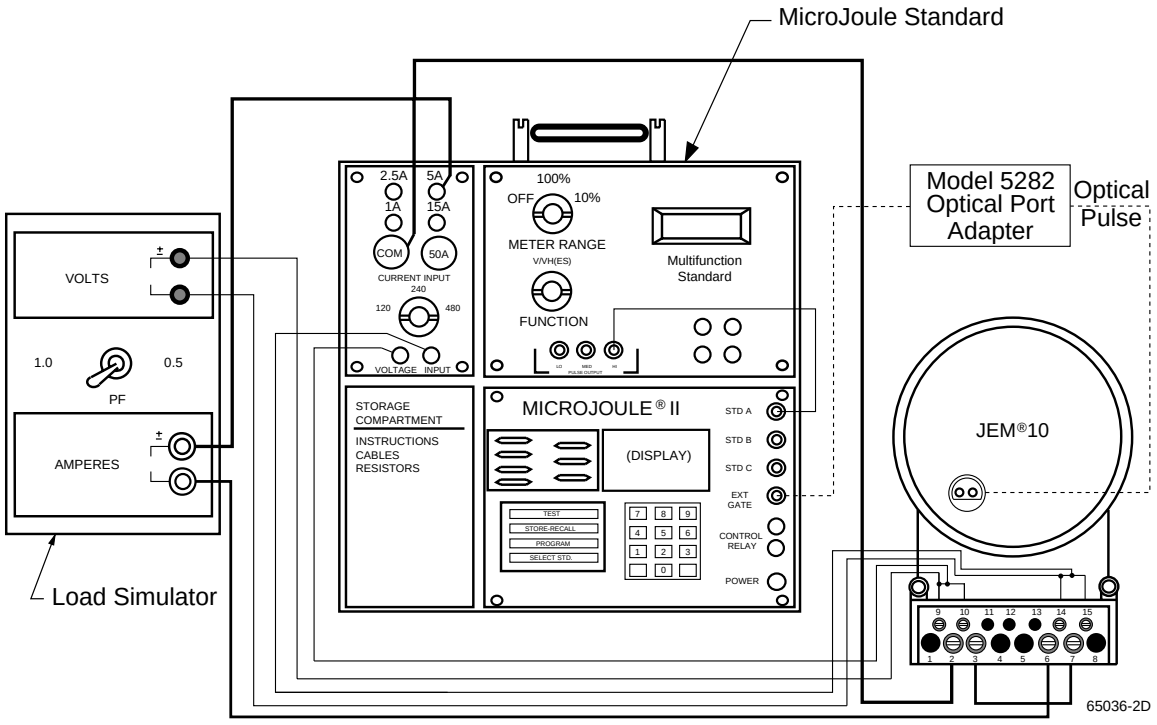


Figure 4-1
Optical Port Test Connection Diagram

4.4 Testing with the SC-30™

Testing with a field standard can be done with manual or automatic gating. Manual gating limits accuracy due to human reaction time. For best results, Scientific Columbus Co. recommends the use of a mechanism to automatically start and stop the field standard gating switch, such as the MicroJoule II computer or the Model 6485A Test Pulse Adapter (TPA).

Since test pulses for the JEM10 are available from both the optical port and the KYZ output channels, a test-pulse adapter may be used with either output. For example, KYZ pulses may be sent to the test-pulse adapter to gate the test with the SC-30. It is also possible to go from the JEM10 to the 5282 Optical Port Adapter to the test-pulse adapter to the SC-30 (or earlier model) for testing with the optical port. A cable connection from the optical-port adapter to the TPA provides an easy hookup. Refer to the Instruction Manual for the Test Pulse Adapter Models 6485A and 6496A for assistance in making this connection (Doc. # YD-08826-001-N).

Figure 4-2 shows the Form 5S JEM10, SC-30, and the TPA 6485A. A test-pulse adapter will pick up infrared pulses from the optical port, count them, and control a gate relay—either directly to the voltage of the SC-30 or to a controlling gate input which is available in the SC-30 or earlier models. The connections to the meter are all standard connections according to the form, voltage, and class of the meter. Connections to the SC-30 are also standard connections as dictated by the SC-10™ Watthour Portable Standard User's Manual. The drawing in Figure 4-2 shows controlling the gate input to the SC-30 with the test-pulse adapter for the duration of the test. In this case, the test is considered an external, gated test started by the optical port. A typical test is 10 or fewer meter-output pulses.

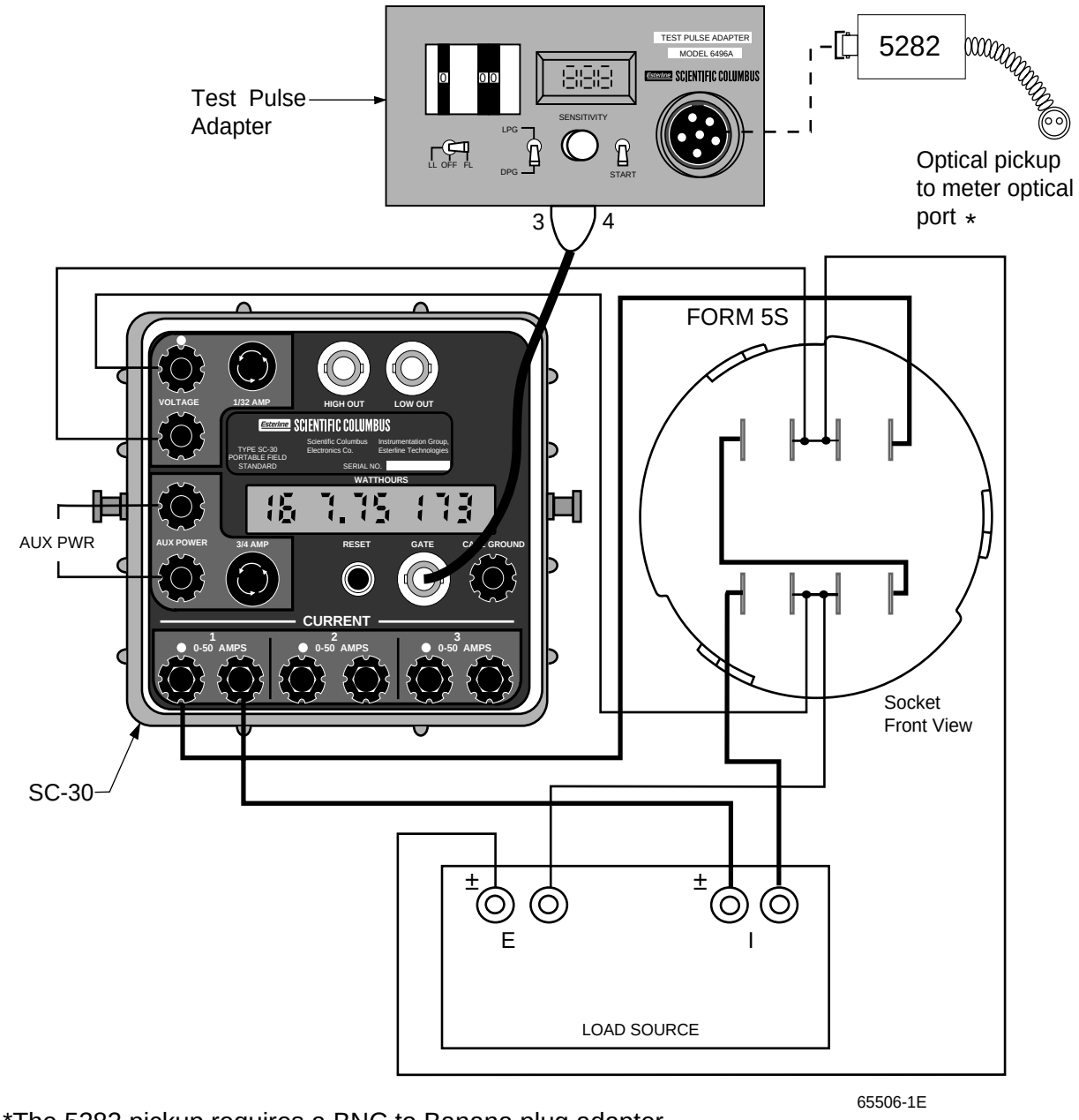
Optical Port Test Calculations

$$Kh_s \times N_s = \frac{K_t \times N_t}{N_e}$$

Where:

N_s = Number of Standard Pulses
N_t = Number of Test Pulses
K_t = Meter Test Constant
Kh_s = Standard Test Constant
N_e = Number of Elements

The test equipment used largely determines the procedural requirements. Some test standards may compute percent registrations while others may provide only standard pulses.



*The 5282 pickup requires a BNC to Banana plug adapter (part no. 10899-001K), when used with the Test Pulse Adapter.

Figure 4-2
SC-30 Test Connection

4.5 JEM10 Calibration

Note: To make calibration adjustments to the JEM10, the hardware key must be installed. The hardware key is located at the top right of the register assembly. The two left-most pins must be shorted to allow configuration or calibration adjustments. The calibration hardware key is only accessible if the globe or the front panel of a switchboard-case meter is removed.

The JEM10 meter can be calibrated directly at the meter with the globe or front cover removed. The following outlines calibration procedures:

➔ **To calibrate the JEM10:**

1. Remove the globe from the A-base or S-base meter, or the front cover from the switchboard-case meter.
2. With the meter in Test Mode, display the consumption quantity to be adjusted. The user can adjust the kWh function when DEL kWh or REC kWh are displayed. Bidirectional quantities cannot be adjusted independently.
3. Simultaneously hold down the DISPLAY and SET buttons. The display shows a value that is to be used for error correction, starting with 00.00. The meter displays the number corresponding to the test register being adjusted. TEST and SET should be flashing on the display.
4. To make a negative correction, first press the SET button. A negative sign appears in the sixth digit space from the right.
5. Adjust the display to obtain the desired error correction. Use the DISPLAY button to select the appropriate place value, and the SET buttons to increment the digits until the desired correction is reached. Negative corrections that decrease registration are assigned a negative sign. Non-assigned values are assumed positive and increase registration.
6. When the desired value has been entered, simultaneously hold down the DISPLAY and SET buttons. This will lock in any corrections. If the meter cannot accommodate the desired change, it will return to the previous display. Otherwise, the meter will return to the selected Test Mode quantity.
7. Repeat Steps 1 through 6 as necessary for other adjustments.
8. Exit the Test Mode by pressing the TEST button.
9. Verify that the meter has returned to its normal metering condition and that the TEST status annunciator is inactive.

Note: The Calibration Mode may be aborted at any time prior to the "lock in" action by simultaneously holding down the DISPLAY and TEST buttons.

Calibrating the JEM10 Analog Option

If the JEM10 meter has a ±1.2mA Analog Output Option installed, the analog outputs can be easily calibrated by performing the following procedure. These adjustments only affect the analog-output signals of the meter and do not affect the JEM10's registration.

Connections

Connect the JEM10 and MicroJoule to a variable voltage, current, and power-factor source by wiring all the voltage elements in parallel and all the current elements in series. Refer to the wiring diagrams for the proper JEM10 model number for the wiring connections and polarities.

The analog-output adjustments are located at the bottom of the meter's faceplate. A set of six potentiometers should be visible as shown in Figure 4.3. For each meter function, there is a zero adjustment and a gain adjustment. If the meter does not have all the functions indicated in this Figure, the adjustment for that set of potentiometers has no effect. The analog-output signal location is dependent upon the meter form. Refer to Section 2.3 for the exact location and pinout.

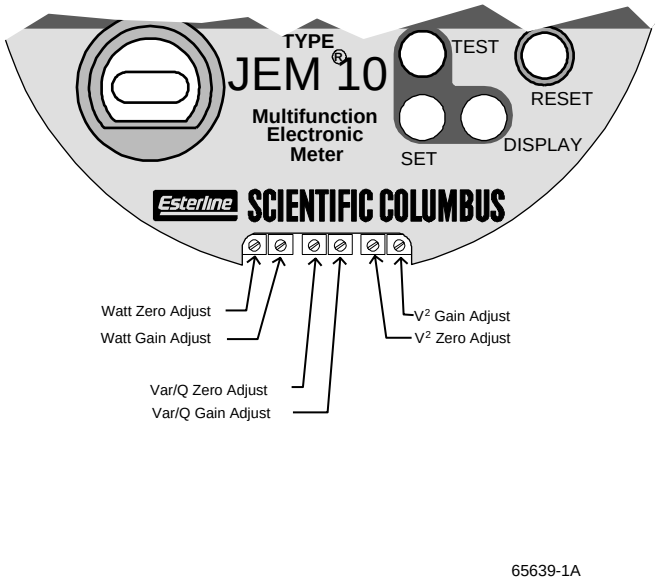


Figure 4-3
JEM10 Analog-Output Option Adjustments

To calibrate the analog output on the JEM10 meter, a precision standard should be used. The MicroJoule Models 6255, 6353, or 6253 with null meters, provide an excellent way of performing analog calibration. If a MicroJoule with a digital null-meter display is not available, a precision standard should be used with an external null meter, bucking the standard against the meter output. Follow the same adjustment procedures. Connect the analog output of the JEM10 to the MicroJoule as shown in Figure 4.4. The precision resistor (tolerance of .025% or better) is selected based upon the MicroJoule voltage and current taps, along with the voltage and current range of the JEM10 meter.

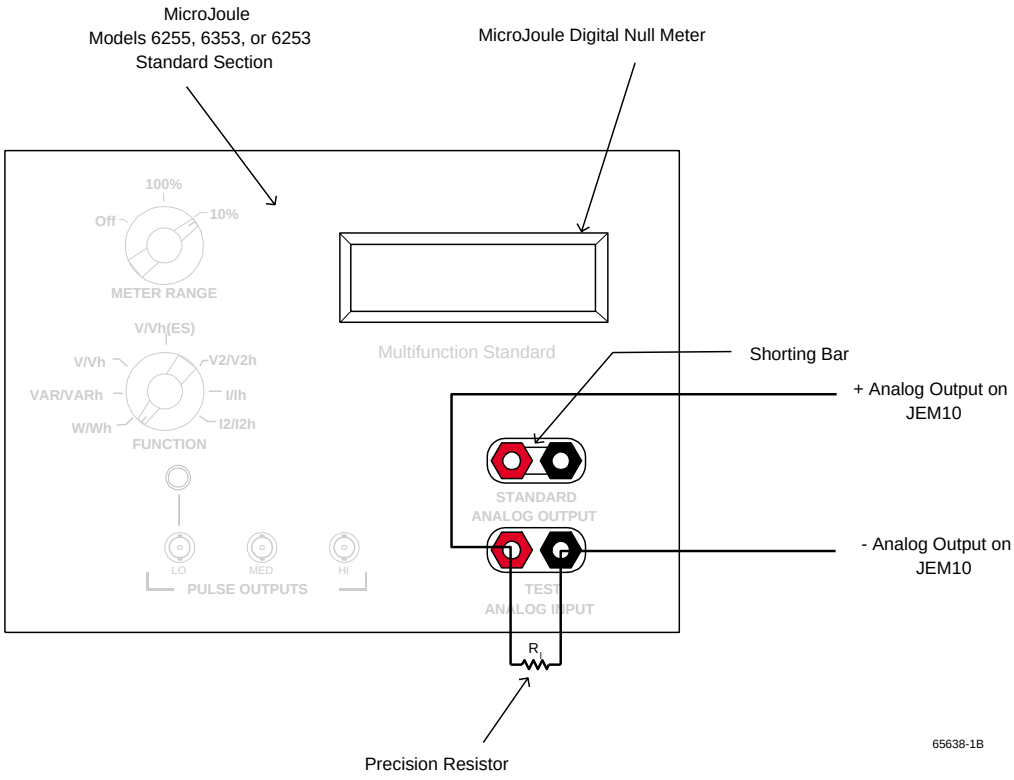


Figure 4-4
Analog Test Setup Using MicroJoule

To determine the precision resistor Rl, the following equations should be used:

For W, Var, or Q tests...

$$R_l = \frac{V_n \times I_n \times N_m}{V_t \times I_t \times N_a} \times 1000$$

For V^2 tests...

$$R_l = \frac{V_n^2}{V_t^2} \times 1000$$

Where:

V_n = Nominal Voltage Rating of Meter
I_n = ½ Class of Meter
N_m = Number of Elements of Meter
V_t = Standard's Voltage Tap
I_t = Standard's Current Tap
N_a = Number of Elements Applied

*For a 2½-element meter, N_m = 3 and N_a = 4.

**Single-element testing on a 2½-element meter does not apply to this equation.

Note: It is important that the zero adjustment is performed first before making any gain adjustments.

Zero Adjustments
To perform a zero adjustment on the JEM10, open the current connections to both the JEM10 and MicroJoule. Adjust the zero adjustment until the MicroJoule's digital null meter reads "0.00" (Meter Range set to 10%). Repeat this procedure for each of the analog outputs. For V^2 adjustments, remove all voltage potentials from the meter and leave auxiliary power applied. To perform this on A-base and S-base meters, the auxiliary-power connection from the transformer base to the power-supply board needs to be removed (connector labeled P8 next to the MOV labeled VR1). The auxiliary power must be applied to connector P8.

Gain Adjustments
Apply full-scale voltage and half-class current to the MicroJoule and JEM10 meter. Adjust the gain potentiometer until the MicroJoule's digital null meter reads "0.00".

5. Maintenance

5.1 Meter Assembly

The JEM10's communication option, KYZ board, and analog boards can be changed in the meter shop with a few simple procedures. Because the multiplier-integrator board and power-supply board are calibrated to the transformer board, Scientific Columbus recommends that the meter be returned to the factory if changes to these boards appear to be necessary.

The JEM10 battery is designed to last the life of the meter under normal storage and usage conditions. If the battery appears to require service, or for more information on any JEM10 components, call Scientific Columbus' Technical Support staff at 800/274-5368 (U.S. and Canada) or 614/718-3870..

5.2 Circuit Board Replacement

The JEM10 meter design, with its snap-together boards, requires few tools for maintenance.

Caution!

All meter work must be performed at static-protected work stations following properly prescribed static-control practices. Refer to Appendix C for more information.

Serial Comm-Option Board

➔ **To remove the serial comm-option board:**

1. Remove power from the meter.
2. Ensure proper grounding for static protection.
3. Remove the globe from the S-base or A-base meter or the cover from the switchboard-case meter.
4. Disconnect the two eight-pin cables located on the comm-option board.
5. Disconnect the ground cable at the comm-option board.

6. Pull the board away from the standoff connecting the comm-option board and the power-supply board. (The standoff remains attached to the power-supply board.)
7. Squeeze the fingers at the top of the comm-option board and carefully pull the board down to disconnect the connector.
8. Place the comm-option board on an antistatic mat.

➔ **To replace the serial comm-option board:**

1. Align the standoff to its receptacle on the comm-option board and press to engage.
2. Carefully align the comm-option board with the connector and register-assembly alignment tabs. Press upward to engage the connector.
3. Reconnect the two eight-pin cables and the ground cable.
4. Replace the globe or meter cover.
5. Supply power to the meter.

Register Assembly

Caution!

Do not apply pressure to the LCD. Excess pressure will cause the LCD glass to break. To avoid scratching the display, lay the board on a soft surface.

➔ **To remove the register assembly:**

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the globe from the S-base or A-base meter or the cover from the switchboard-case meter.
4. Squeeze the fingers of the comm-option board while pulling the board toward the Transformer Board until it is dislodged from the Register Assembly.
5. Turn the ejector screw one-half turn clockwise to eject the register assembly from the mating connectors. Be careful not to lift this side of the assembly any further before proceeding to the next step.
6. Squeeze the fingers at the top of the KYZ board together while gently lifting the register assembly out of the meter.
7. Place the detached register assembly on an antistatic mat.

➔ **To replace the register assembly:**

1. Align the connector pins at the top of the register assembly with the receptacles at the top of the multiplier/integrator board and power-supply board.
2. Squeeze the fingers at the top of the KYZ board together while inserting the fingers into the slots at the bottom of the other side of the register assembly.
3. Re-engage the first side (connector side) of the register assembly by turning the ejector screw one-half turn counter-clockwise while firmly applying downward pressure on the register assembly with your hand.

4. Re-engage the comm-option board by squeezing the fingers at the top of the comm-option board and inserting the fingers into the slots on the bottom side of the register assembly, being careful to align the connector pins.
5. Replace the globe or meter cover.

Analog-Option Board

➔ **To remove the analog-option board:**

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the globe from the S-base or A-base meter or the cover from the switchboard-case meter.
4. Firmly grasp the sides of the analog-option board at the top of the board.
5. Gently, but firmly, pull the board away from the KYZ board. If the board does not automatically release at the bottom, grasp the bottom of the analog-option board and pull the board away from the KYZ board.
6. Place the board on an antistatic mat.

➔ **To replace the analog-option board:**

1. Align the standoff at the bottom of the analog-option board with its receptacle on the KYZ board and align the board connector carefully. Snap the board into place by applying pressure directly on the connector.
2. Follow by aligning the standoffs at the top of the KYZ board with their receptacles on the KYZ board. Snap the board into place by applying pressure directly on the standoff pins.

KYZ Board

➔ **To remove the KYZ board:**

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the globe from the S-base or A-base meter or the cover from the switchboard-case meter.
4. Remove the comm-option board.
5. Remove the register assembly as previously outlined.
6. Unplug the two KYZ cables from the KYZ board.
7. Disconnect the ground cable from the transformer board.
8. Disconnect the board from the power supply and integrator/multiplier board by carefully pulling the board in an outward direction.
9. Squeeze the fingers at the base of the KYZ board and carefully lift the board out of the transformer board at the base.
10. Place the KYZ board on an antistatic mat.

➔ **To replace the KYZ board:**

1. Snap the KYZ board into position in the transformer board by squeezing the fingers on the base of the KYZ board and inserting them into the appropriate slots in the transformer board.
2. Connect the KYZ board to the power supply and multiplier/integrator board.
3. Reconnect the two KYZ cables and the grounding cable.
4. Replace the register assembly as previously described.
5. Replace the comm-option board.
6. Replace the globe or meter cover.
7. Return power to the meter.

5.3 Firmware Upgrade

The meter firmware is located on the CPU board of the register assembly.

➔ **To replace the firmware:**

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the globe from the S-base or A-base meter or the cover from the switchboard-case meter.
4. Remove the comm-option board.
5. Remove the register assembly.
6. Use a chip extractor for a 32-pin DIP package to remove the EPROM which is located at the center of the register assembly.

Caution!
When replacing the firmware, do not apply pressure to the LCD. Excess pressure will cause the LCD to break.

7. Position the new EPROM, noting the correct orientation. Align the notch at the top of the EPROM with a notch silk-screened on the CPU board.
8. Replace the register assembly.
9. Replace the comm-option board.
10. Perform a cold start by pressing the DISPLAY, SET, and TEST buttons on the meter face while applying power to the meter.
11. Replace the meter globe or cover.
12. Reconfigure the meter.

5.4 Health Diagnostics

The JEM10 health-status register provides an indication of the health of the meter. It is one of the status registers that can be programmed to be displayed in any of the registering display modes (Normal, Alternate, or Test). An “E” on the JEM10’s display indicates that a health condition is present and that the health-status register should be viewed. The JEM10 meter should never have a health-status error; however, in the unlikely event, the following information should be used to interpret the problem. Contact Scientific Columbus so the situation can be investigated.

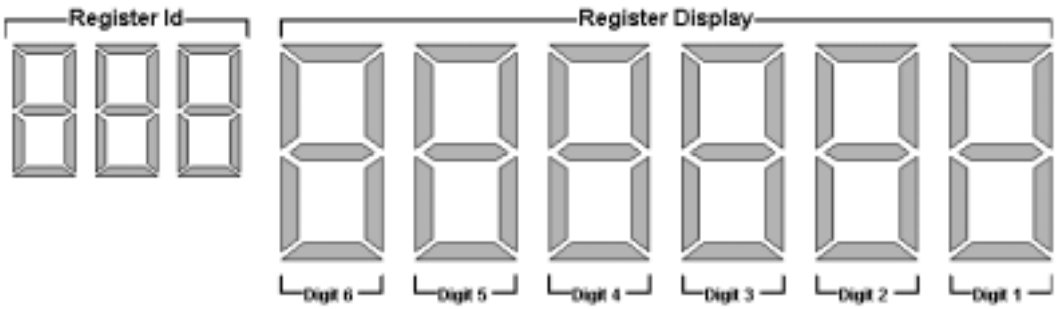


Figure 5-1
JEM10 Register Display

The health-status register is interpreted by using the following charts. Only the right five digits of the display are used. An "E" on the JEM10's display indicates that a health condition exists. View the health-status register and note the digit that is non-zero. Find the appropriate chart for the digit indicating a health-status condition. Locate the number and reference what error condition(s) it represents.

Digit 1 Equals →	1	2	3
Configuration Error		X	X
Restart Error	X		X

Digit 2 Equals →	1	2	3
Power Fail Critical		X	X
Restart Error	X		X

Digit 3 Equals →	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
RAM Error								X	X	X	X	X	X	X	X
Restart Error				X	X	X	X					X	X	X	X
Clock Status		X	X			X	X			X	X			X	X
PROM Checksum	X		X		X		X		X		X		X		X

Digit 4 Equals →	A–F
Battery Time (exceeded in years)	X

Digit 5 Equals →	1	2	3	4	5	6	7
Load-Profile Discrepancy		X	X		X		X
PIC Checksum	X		X			X	X
PIC Init Failure				X	X	X	X

Digit 6 Equals →	1	2	3
Not Used			

Description of Health Items

Register Data—This indicates that a condition occurred that affected the meter registering information.

Config Error—Some configuration parameter was improperly sent. The meter should be cold-started and reconfigured. For complete diagnosis of this error, contact Scientific Columbus and provide a copy of the configuration file.

Restart Error—A restart error indicates that an unexpected restart occurred on the meter. A Billing Period Reset will clear this error.

Power Fail Critical—An error occurred during a power outage. A Billing Period Reset will clear this error.

PROM Checksum—This indicates that the PROM Checksum is incorrect. This could indicate a faulty component used to store program information. Perform a Billing Period Reset to clear the error. If the error repeats, replace the firmware memory chip with the latest version of JEM10 meter firmware, available from Scientific Columbus.

Clock Status—An error occurred with the real-time clock of the meter.

Hardware Error—This indicates that some internal hardware within the meter failed.

RAM Error—This indicates a problem with internal RAM to the JEM10 meter.

Battery Time—This indicates that the total time (in hex years) running on the battery has exceeded ten years (where A = 10 years, B = 11 years, C = 12 years, etc).

PIC Checksum—This indicates that some problem exists with the metrology board of the JEM10 meter. Perform a Billing Period Reset to clear the error. If the problem continues, contact Scientific Columbus so the occurrence of this error can be investigated.

Load-Profile Discrepancy—This indicates that some problem occurred with the load-profile storage.

6. Theory of Operation

6.1 Technical Overview

The JEM10 is an extremely accurate, solid-state, multifunction meter based on the time-proven measurement techniques used in Scientific Columbus' original JEM® Meter and in its most accurate transducers and calibration standards. JEM10 offers new capabilities and new packaging (S-base, A-base, and switchboard case) in a design that provides maximum-value metering solutions.

The JEM10 basic model measures watts and vars using an analog time-division-multiplication circuit first applied in Scientific Columbus' Digilogic™ Transducers, providing better performance with influence factors such as temperature, load, voltage, frequency, and harmonic distortion.

The multiplier/integrator section receives the scaled voltage and current analogs from the transformer section and performs time-division-multiplication extraction of watt, reactive, and volt-squared quantities. These analog quantities are sent to the optional analog-output board which produces bidirectional watts and reactive power (vars or Q) and volts squared.

These analog values are also integrated and converted to five pulsed signals (±watthours, ±reactive hours, and V^2 hours) on the multiplier/integrator board. These five pulse signals are sent to the optional KYZ board, which produces standard, Form-C outputs, and to the register (CPU) board.

The CPU board accumulates pulsed data from five inputs and stores it in the load-profile buffer along with various events. Up to 40 days of five channels of data (using 15-minute intervals) can be stored along with an average number of events. This data is available to various data systems through either of the two serial ports. The CPU also processes the five pulse inputs and stores a variety of configured (along with all other) meter variables through a proprietary software package called JEMSET.

Register data is available in one of three modes (Normal, Alternate, and Test) through the LCD display on the meter or through one of the two serial ports.

In addition to the analog and KYZ optional outputs, alarm and status signals are available through the KYZ interface board. Two serial ports are available on every JEM10 meter. An optical port is available through the meter front panel and is standard on all three package configurations, and an optional RS-232 port (or optional 20 mA) is available through rear connectors or terminal strips.

The meter's configuration is completely programmable through an intuitive, PC-based software package called JEMSET. JEMSET allows the user to configure load-profile storage, demand and consumption registers, display configuration, communication protocols, and many more features. Each meter comes with a default configuration allowing instant operation of meters as they are first installed. This default configuration can be overridden by downloading a new configuration file from JEMSET through either of the two serial communication ports.

JEM10 also can be purchased with a 9600-baud modem with a call-home-on-power-outage feature. This board is installed in place of the serial-communication option board.

Finally, JEM10 communicates with various data systems including Scientific Columbus' JAV and the widely used MV-90 system supplied by Utility Translation Services (UTS). Both systems read load profile, register, and health-check data.

Note: For more information about MV-90, call Utility Translation Services at 919/876-2600. For more information about JAV, call Scientific Columbus at 800/274-5368 (U.S. and Canada) or 614/718-3888.

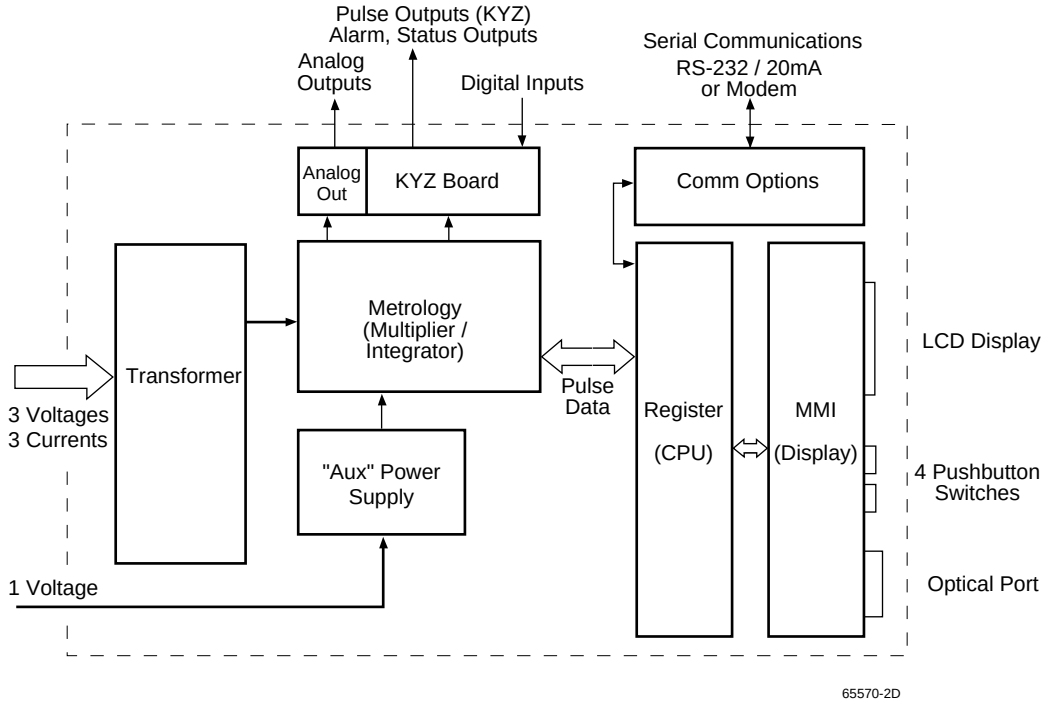


Figure 6-1
JEM10 Functional Block Diagram

6.2 Hardware Function

In reference to the JEM10 functional block diagram in Figure 6-1, each of the major hardware elements is described below.

Transformer Board

The JEM10 transformer board provides the voltage and current signals used by the multiplier. Located at the base of the meter, it contains the voltage- and current-signal transformers. The number of transformers and the connections to the base vary with the meter form. The primary inputs to the JEM10 signal transformers are the transformer-rated voltage and current signals from the service connection. The secondary outputs of the signal transformers provide analog signals to the multiplier board proportional to the primary voltage and current inputs. The signal transformers are actively unloaded to compensate for their losses. The analog signals are passed to the multiplier board as currents to negate the contact resistance of connectors and to provide high-noise immunity.

Multiplier/Integrator (Metrology) Board

The JEM10 metrology board mounts directly onto the transformer board. It contains three independent multipliers with three corresponding integrators and support circuitry consisting of a precision-voltage reference and a triangle-wave generator. The metrology board receives the current signals from the transformer board and converts them to voltage signals of approximately 7 Vrms at class amps and nominal voltage.

- **Multipliers**

  Each multiplier is associated with a specific function. The first multiplier is dedicated to the watt function. The second is associated with reactive power and may be configured for either vars or Qs. The third multiplier is connected to "A"-phase signals only and may be configured for volts or volts squared. The outputs of the first two multipliers are bidirectional and the output of the third is unidirectional.

  Watt Function—The first multiplier is dedicated to the "watt" function. A signal representing "A"-phase input voltage is compared to the precision triangle wave. The result of this comparison is a pulse-width-modulated (PWM) signal in which the duty cycle (width) is proportional to the magnitude of the input voltage. This modulated signal is used to switch the signal representing the "A"-phase current into a summing junction causing an amplitude modulation (AM) of the processed signal. This summing junction is the virtual ground of an operational amplifier that also provides ripple filtering.

On one polarity of the PWM signal, the noninverted current signal is sent to the summing junction. On the opposite polarity, an inverted version of the current signal is sent to the summing junction. This operation is repeated for each set of phase voltages and currents. The summing circuit adds the products of each separate multiplication and provides a dc voltage output that is proportional to the sum of the products (total watts) of the input signals. The watt output is 10 Vdc for full-scale inputs of nominal voltage and class amps at unity power factor. The output is bidirectional and is positive for power delivered.

Var Function—The second multiplier may be configured for either var or Q functions. When configured for the var function, the multiplier uses active phase shifters to obtain a 90° phase shift of the voltage signals before the multiplication. The 90° phase shift is accomplished in two steps. An operational amplifier circuit initially provides a 90° phase shift but also inverts the signal. To compensate for this inversion, an additional 180° phase is implemented by wiring the electronic-switch controls complimentary to the wiring for the watt function. This provides the correct 90° phase shift. From this point, the operation of the var multiplier is identical to that of the watt multiplier. The output of the var multiplier provides a dc voltage that is proportional to the product of the per-phase input signals and the sine of the angle between them. The var output is 10 Vdc for full-scale inputs of nominal voltage and class amps at 90°. The output is bidirectional and, for lagging vars, the output is positive.

Q Function—The JEM10 implements the Q function by the proper cross phasing of the voltage and current signals to obtain an effective 60° lag in polyphase connections. This cross phasing is internal to the meter and no external cross phasing is required. The internal cross phasing is accomplished by configuring the second multiplier for the Q function. Configuration of the multiplier for the Q function is based on the following equations:

3 element: $Q = Ecn(-Ia) + Ean(-Ib) + Ebn(-Ic)$
2½ element: $Q = Ecn(Ic - Ia) + Ean(Ic - Ib)$
2 element: $Q = Eac(Ia) + Eab(Ic)$

The Q function utilizes the same circuitry as the var function, with the exception of the active phase shifters. The voltage signals are connected directly to the second set of comparators bypassing the phase shifters. The PWM signals generated by the comparators switch the appropriate current signals into the summing circuit. The cross phasing of the signals required by the Q function occurs at the switches. The Q function output is valid for power factors of 30° leading to 90° lagging.

The output is 10 Vdc for full-scale inputs of nominal voltage and class amps at power factor of 60° lagging. The output is bidirectional and, for lagging Q and watts delivered, the output is positive.

Volt-Squared Function—The function is single phase and is referenced to the phase "A" voltage input. The operation of the multiplier for this function is similar to that of the watt function. A PWM signal is generated by comparing the input-voltage signal to the triangle wave. This PWM signal then switches a current generated by the same input-voltage signal into the summing circuit and filter. The output of the multiplier is proportional to the input signal multiplied by itself. An input of 120 V produces a 5 Vdc output.

The outputs of the multipliers are sent to two places. The five channels are sent to the optional analog board (mounted to the KYZ board) and to the integrator portion of the metrology board.

■ I**ntegrators**

The JEM10 metrology board contains three independent charge-balanced integrators operating in the voltage mode. The integrators perform an analog-to-frequency conversion of the analog signals produced by the multipliers—producing pulse rates proportional to energy. Two of the integrators are bidirectional, operating with positive or negative input signals from the first two multipliers. The third integrator is unidirectional and is associated with the third multiplier. A precision crystal-controlled oscillator provides a common reference clock for the integrators. The maximum pulse-output rate of the integrators at nominal voltage, class amps, and unity power factor is 1,728,000 cph (480 Hz). Other pulse rates are selected when external factors, such as PT and CT ratios, offset the value of each pulse. The output-pulse rate of each integrator is programmable via software.

The output of each integrator is then sent to the optional KYZ board and to the register board via their own programmable dividers, thus enabling the user to perform calibrations at the meter.

Register (CPU) Board

The register (CPU) accumulates pulse data provided by the integrator circuits and calculates volt-amperes and power factor. A microprocessor controlled by programmed PROMs (firmware) processes meter data into displayable registers of energy and reactive consumption, demands, and load-profile information. In addition to providing display registers and user interface, the register handles serial communications I/O through the optical port and an additional remote serial port option.

- **Demands**
  The register calculates all required demand quantities from the watthour and varhour (or Q-hour) inputs from the metrology board.

- **Volt-Ampere Calculation**
  Volt-amperes are calculated at the end of each interval and are available as demand readings only. Total volt-amperes equal the square root of the sum of total watts squared and total vars squared.

- **Power Factor Calculation**
  A power factor is computed for the interval associated with the peak kW or kVA. The JEM10 meter has two types of power factor—power factor coincident with peak demand and average power factor for the billing period.

Power Supply

The JEM10 power-supply board plugs into the transformer board and runs parallel to the multiplier/integrator (metrology). Power is typically received from the phase "A" potential input on the transformer board. Switchboard models have externally accessible auxiliary-power terminals which may be connected to any suitable source of 60 Hz power.

The incoming voltage is transformed down through two isolated, secondary transformer windings to appropriate levels. Each is full-wave rectified and filtered. One isolated output feeds a precision, three-lead regulator which provides the regulated 5 V output needed by the meter's digital circuits. An output signal is provided in advance of the regulator and used by the CPU for impending power-loss detection. This signal provides sufficient advance warning to the CPU for orderly shutdown sequences to take place on loss of power.

The other secondary winding is center tapped to provide two full-wave, rectified and filtered dc outputs of opposite polarity. These outputs feed two precision, three-lead regulators which regulate plus and minus 15 Vdc, respectively. These supply the JEM10's analog signal conditioning and computing functions.

One side of the center-tapped secondary winding's ac voltage is coupled through a signal limiter to a two-stage, low-pass filter. This arrangement produces a reliable, noise-free replica of the power lines' fundamental frequency. This clean signal is fed into a comparator employing balanced hystereses, digital buffering, and noise limitation and is delivered to the CPU for its time-keeping options.

Power Loss Handling

Handling of loss of ac power (including considerations of the power supply, register, memory data integrity, battery operation, power fail detection, and pulse outputs) is an important aspect of the JEM10 meter. The following is a description of how various aspects of the meter (including data integrity) are handled during power loss:

- **Power Supply**
  Loss of power is detected by monitoring power-supply signals, and a power-fail signal is sent to the register and pulse-generation circuits. The power supply provides enough margin to allow time for an orderly shutdown of register functions while insuring integrity of data.

- **Register and Pulse Counting**
  Prime requirements for the meter are that the register power-down and restoration processes insure that no data is lost or altered because of the power interruption.

  Implementation of the JEM10 design insures that each of these requirements is met. Energy detected and accumulated by the measurement circuit which has not resulted in a pulse to the register is retained in the measurement circuit for at least 15 minutes during a power outage. That is, the partial pulse representing energy being accumulated will not be lost because of a short power outage.

  Pulse-output devices are forced to the open condition upon detection of an impending power loss. After restoration of power for a sufficient time to allow the meter to resume normal operation, the KYZ devices are restored to the same condition as before the outage without any other transitions of the contact devices. Properly designed receivers for three-wire (Form-C) pulses will not register false counts under these conditions.

- **EODIP Pulse Output**
  The output is a two-wire, normally open output. If it was closed at the time a power outage occurred, it will open on power fail and not return to the closed state (until the next interval end) regardless of the length of the power loss. EODIP pulses do not occur when auxiliary power is out at the meter and a demand interval time is past. Also, EODIPs that should have occurred are not made up after restoration of power.

- **Display**
  The display is blanked during power outages except as noted for potential indicators. Display sequence is restarted with a segment test in the normal Scrolling Display Mode. The meter does not return to the previous display item.

  Potential Indicators—Potential indicators are not under the control of the microprocessor of the register (CPU) board and, therefore, will not be controlled during power outage but will respond to the level of line voltage available to drive them. Other elements of the register's display will be turned off when a power failure is detected. The potential indicators may continue to operate at a lower-level voltage, down to as low as half of the rated voltage. They will begin to dim noticeably at the power-fail level before they are completely extinguished. The same applies to the restoration of power. If within an unspecified operating voltage level, the potential indicators may be partially on.

  Load Rate Indicators—Load-rate and direction indicators are extinguished during a power-loss condition.

- **Elapsed Time On The Battery**
  Evaluation of elapsed power-outage time is used to determine the time that the battery has been exposed to power drain. After each power outage, the quantity is updated by adding the time of that particular power outage to the total battery operating hours. This information can be used as an indication of the need to replace the battery which is used to maintain critical memory data.

  The JEM10 battery is designed to last the life of the meter based on normal power-outage frequency.

- **Time Keeping During Power Outage**
  During a power outage, the time of the outage condition is recorded to a nonvolatile memory. Upon restoration of ac power, the elapsed time of the outage is used to adjust the time clock of the meter and to make adjustments for other events that would have transpired during the elapsed time had the power not failed.

- **Handling of Demands During and After a Power Outage**

  For purposes of describing demand handling during power outages, some definitions of power-fail conditions are necessary because the handling of data depends on the length of the power outage. A user-definable time (minimum power-outage definition) is available. A power outage is recognized only after this time expires. The range of minimum power-outage definition is from zero (near instantaneous) to one minute. Handling of demand data is described below for both momentary power fail and power outage.

  Power Fail—*A momentary loss of ac power less than the user-configured minimum power-outage definition.* For purposes of calculating a demand, data accumulated in an interval or subinterval prior to the outage is carried over into the continuing calculation for demand for the present or next interval as if the power loss had not occurred. In the event that an interval would have ended during the time of the power loss, demand will be calculated as if the interval had ended using data that was recorded. If Demand Deferral is configured, it will not be activated by a power fail shorter than the power outage defined. Also, a power-fail event is not recorded in load-profile memory.

  Power Outage—*Any power loss that exceeds the configured minimum power-fail time.* Demand calculations are handled the same as Power Fail (listed above), unless Demand Deferral is enabled. In this case, demand calculations use only data accumulated before the power outage. All data accumulated after power is restored is ignored for the number of interval closures programmed for the Demand-Deferral parameter. A power outage is recorded in load-profile memory.

- **Demand Deferral**

  Demand deferral is defined as the number of interval closures after a power outage for which data collection for demand calculations is suspended. This parameter can be set up through JEMSET.

- **Load Profile**
  An event is stored in load-profile memory to mark the power outage. The event is stored only if the power loss is longer than the configured time of a power-outage definition. The event consists of the time that the power outage occurred, the point that it was restored, and the identification of the event itself. Event storage is compatible with JEM®2 Binary Protocol data storage and the meter is compatible with JAV Data System Retrieval. If an event was scheduled to occur during the time of the power down, the meter will not create the event as if it occurred at that time, as this would create a discontinuity in the power-fail record itself. For example, a billing-period-reset event scheduled during the time of the power-down should be executed and inserted in the event record at the earliest reasonable opportunity after complete power restoration. Some events recorded in the meter's loadprofile memory create pre-event and post-event partial intervals. This type of event includes time sets, power outages, limited resets, communications freeze, daylight-saving time adjustment, and any other event which is recorded in the meter's load-profile memory.

- **Test Mode**
  The meter will exit Test Mode on any power-fail condition. When power returns, the meter returns to normal metering condition and displays normal registers beginning with the segment test.

- **Health Checks**
  Health-check conditions or diagnostic indications are extinguished during power loss. They are returned to their previous status upon restoration of power. Diagnostic error flags that are not persistent are cleared by a demand reset.

- **Communication**
  Serial communication is terminated by a power loss. A command received (but not executed) just prior to an outage will be aborted. An in-process response during power loss will be aborted. A meter configuration which has not been completed will be aborted.

6.3 Time-of-Use (TOU) Metering

The JEM10 meter has a flexible and programmable TOU metering feature. Applicable TOU-measured quantities include: consumptions, maximum demands, time of maximum demand, and coincident demands. (Power factor for billing period and short-interval demands are not applicable to TOU rates.) Each measurement quantity is assigned, using JEMSET, to one of five rates—A, B, C, D, or Total.

TOU Rate Schedules

There exist four TOU rates (A,B,C, and D) that can be applied to four separate, daily rate schedules that are identical in structure but contain different information. TOU rates and schedules are programmable using Scientific Columbus' JEMSET program.

Each schedule consists of up to nine day types:

- Sunday
- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Holiday 1
- Holiday 2

and each day type can consist of up to eight TOU period changes.

TOU Demand Registers

The TOU demand register performs demand calculations during a TOU period based on energy used during that period. When a TOU period changes the demand interval, closing times are not related and may not coincide.

When the present period TOU schedule changes, demands are restarted. The meter will accumulate demands from the beginning of the most recently activated TOU schedule. The meter will not carry remaining, partial-interval data forward to a future TOU register calculation.

TOU Specification Summary

The TOU schedule accommodates a 20-year calendar of holidays, automatic daylight-saving time changes, and leap-year changes.

Number of holidays	200
Season changes/year	4
Day types	9
Rate changes/day	8
Rate types	4 (plus total)
Automatic demand reset	At TOU season change or specified day

Seasons

- **Change**
  The season change date occurs at the midnight immediately before a given season start date. A season rate schedule is in effect until the next chronological season start date. Demand registers normally modified by a demand reset are modified when the season change occurs only if an automatic demand reset is scheduled at the season change. A seasonal storage register may receive any demand register value at the time of the change.

- **Storage Registers**
  The meter displays registers (identical to demand-reset storage registers) to reflect readings at the time of TOU season change. Readings for specific registers are transferred into these seasonal storage registers when a season change occurs.

- **Holidays**
  Holiday schedules contain dates for up to 200 holidays, each of which are defined as either “holiday 1” or “holiday 2.” JEMSET allows the identification of the holidays to suit specific applications.

- **Automatic Demand Reset**
  The meter performs a season-shift demand reset when TOU and seasonal-shift demand resets are enabled.

- **Periodic Changes**
  Demands are calculated on registers with the prior rate. All subinterval accumulators for a specific rate are cleared allowing the new rate calculation to contain data that occurred in the new rate period. When periods change and keep the same rate, accumulators are not cleared.

- **Enable/Disable**
  The TOU function can be enabled or disabled through meter configuration using JEMSET. When disabled, TOU functions, including season change detection, will not operate.

6.4 Load Profile

With its built-in pulse recorder, the JEM10 meter is capable of storing up to five channels of pulse data information. Each channel corresponds to a quantity that the meter can measure. Data is stored as load-profile pulse information. Each pulse has an associated pulse constant that determines the value of a pulse.

Storage frequency is based on a load-profile interval length. This length (in minutes) determines evenly the frequency of pulse information storage for each channel. Interval length can be any number divisible into 60 minutes.

The load-profile intervals resemble demand intervals, but can be set independently. The interval closures occur on even increments within the hour. For example, a 15-minute interval will begin on the hour and will close at 00:15; the next interval will close at 00:30; the next interval will close at 00:45; etc. At the end of each interval, the meter records the number of pulses accumulated since the last load-profile interval closure or special event. When the load-profile data storage memory is full, the meter will overwrite the oldest information. The number of days of storage available is determined by the load-profile interval length and number of channels stored. Storage also depends on the data system used.

Scientific Columbus' JAV data-retrieval program can retrieve a limited amount of load-profile data as the meter emulates a JEM2 meter when interrogated by JAV. MV-90 or other data systems designed to fully implement the storage capability of the JEM10 meter are not limited by this restriction.

Load-Profile Event Data Storage

The JEM10 meter records special event type, stop time, and start time into load-profile data storage. Because these events are recorded directly to load profile, the amount of load-profile accumulation between or up to each event is also recorded. The following events can be stored:

- **Power Fail**
  Indicates that the meter has lost auxiliary power. If a meter does not have separate auxiliary power, a power outage typically will result in the loss of at least one phase of power. The time of power fail and time of restoration are recorded.

- **Time Set**
  The beginning and end of a time set are recorded in load-profile memory. Time set can be performed at the meter or by use of serial communications.

- **Daylight-Saving Time**
  Adjustment events are stored. Changes are programmed via the JEMSET program. The DST change start and stop times are recorded.

- **Test Mode**
  Entries and exits are recorded as events. No load-profile data is recorded during the Test Mode. Test Mode can be initiated at the meter or through serial communications.

- **Configuration Event**
  A configuration event and the associated freeze-sequence number are stored in the load-profile memory. Load-profile data is erased when any load-profile-related parameter is configured. The configuration event is executed only through serial communications.

- **Freeze Event**
  A freeze event will cause the meter to take a snapshot of the Normal- and Alternate-Mode registers. When the meter reads these registers, the value stored at the time of the most recent freeze event is returned. This event is executed only via serial commands.

- **Initialization**
  Event indicates the time of the last initialization. It must be initiated from the meter.

- **Demand Reset**
  Indicates the time of storage-register updates and register clearing. This command can be initiated from the meter or through serial communications.

Load-Profile Retrieval

Load-profile information retrieval can be performed only through serial communications.

Retrieve data with Scientific Columbus' JAV software or by UTS' MV-90 software linking with either the direct optical, direct RS-232, 20 mA current loop, or a modem. The protocol that determines the information transfer method is public domain and can be obtained from the factory. Scientific Columbus' Technical Support staff recommends that only experienced programmers fluent in communication interfaces undertake such a task.

The user can retrieve load-profile information by requesting a specified number of days of data. The data system requests either all load-profile data or a partial read by requesting the number of days to download. The meter also can perform a partial read of up to 40 days of data. The meter will download requested data, oldest information first, and

transmit the data in 64-byte packets. After each packet is sent, the meter waits for an acknowledgment indicating that the previous information was received properly. After receiving the acknowledgment, the meter will send the next information packet.

When the data system retrieves requested information, it can process the data into report graphics or translate the data into a spreadsheet. Each interval of load-profile information can be associated with time-facilitating, load-curve analysis.

External-Synchronized Load-Profile Interval Closures

Load-profile interval length should match demand-interval length. External interval tracking in the meter affects the load-profile channels. For that reason, load-profile interval length should match demand-interval length.

When configured for external synchronization, the meter uses two time sources—one for determining interval closure and one for the meter's real-time clock. For that reason, data skewing is possible if a synchronization pulse occurs on the load-profile interval boundary.

Default Configuration

The following is a listing of the default configuration in the JEM10 meter after a cold start is performed.

Primary Calibration (secondary readings)

PTR = 1/1
CTR = 1/1

Demand Information

Autodemand Reset enabled on first day of each month
Autofreeze disabled
Auto Season Demand Reset disabled
Demand Reset Lockout = two intervals
Demand Deferral disabled
Demand Interval = 15-minute block interval
End-of-Demand-Interval Pulse Output enabled
External Demand Sync disabled
Var Algorithm = standard

Miscellaneous Information

Clock Sync = line
Date Format = MM/DD/YY
DST Adjustments enabled
Line Frequency = 60 Hz
Set Mode Timeout = 5 minutes
Test Mode Timeout = 30 minutes
Time of Use disabled
Scroll Rate off
Manual Register Presets enabled

Load-Profile Assignments

Last programmed settings are not reset on cold start. Parameters shown here are factory settings (if the meter has never been programmed using JEMSET).

Interval Length = 15 minutes
Load-Profile Response Size = 38K

1. kWh Del K_m = 1.00 wh/c
2. kWh Rec K_m = 1.00 wh/c
3. kvarh Del K_m = 1.00 varh/c
4. kvarh Rec K_m = 1.00 varh/c
5. V^2h K_m = 10.0 V^2h/c

Communications

HiLevel Password = 000000
LoLevel Password = 000000
Comm Option Address = 01
Comm Option Baud Rate = 1200
Optical Port Address = 02
Optical Port Baud Rate = 9600
DTR Pulse Width = 100 ms
RTS to Tx Delay = 0 ms
Tx to RTS Delay = 0 ms
Meter ID = 10

Pulse Outputs

Last programmed settings are not reset on cold start. Parameters shown here are factory settings (if the meter has never been programmed using JEMSET).

1. kWh Del K_e = 1.00 wh/c
2. kWh Rec K_e = 1.00 wh/c
3. kvarh Del K_e = 1.00 varh/c
4. kvarh Rec K_e = 1.00 varh/c
5. V^2h K_e = 10.0 V^2h/c

Internal Modem Settings

Phone-Home Modem disabled
Voice Call Delay disabled
Answer After Two Rings
Answer Window disabled

VAR METER DEFAULT REGISTERS

Normal Registers

ID	Quantity	Display
001	TIME PRESENT	
002	DATE PRESENT	
003	KWH DEL	####.##
004	KWH REC	####.##
005	KVARH DEL	####.##
006	KVARH REC	####.##
007	V2H DEL	#####.#
008	KVARHQ1	####.##
009	KVARHQ2	####.##
010	KVARHQ3	####.##
011	KVARH Q4	####.##
012	MAX KW DEL	###.###
013	TIME OF PEAK KW DEL	
014	MAX KW REC	###.###
015	TIME OF PEAK KW REC	
016	MAX KVAR DEL	###.###
017	MAX KVAR REC	###.###
018	MAX KVA DEL	###.###
019	MAX KVA REC	###.###
020	POWER FACTOR AT KW DEL MAX	##.##
021	POWER FACTOR AT KW REC MAX	##.##
022	AVERAGE POWER FACTOR	##.##

Alternate Registers

ID	Quantity	Display
101	TIME OF BPR	
102	DATE OF BPR	
103	KWH DEL STORAGE	####.##
104	KWH REC STORAGE	####.##
105	KVARH DEL STORAGE	####.##
106	KVARH REC STORAGE	####.##
107	V2H DEL STORAGE	#####.#
108	KVARHQ1 STORAGE	####.##
109	KVARHQ2 STORAGE	####.##
110	KVARHQ3 STORAGE	####.##
111	KVARH Q4 STORAGE	####.##
112	MAX KW DEL STORAGE	###.###
113	TIME OF PEAK KW DEL STORAGE	
114	MAX KW REC STORAGE	###.###
115	TIME OF PEAK KW REC STORAGE	
116	MAX KVAR DEL STORAGE	###.###
117	MAX KVAR REC STORAGE	###.###
118	MAX KVA DEL STORAGE	###.###
119	MAX KVA REC STORAGE	###.###
120	POWER FACTOR AT KW DEL MAX STORAGE	##.##
121	POWER FACTOR AT KW REC MAX STORAGE	##.##
122	AVERAGE POWER FACTOR STORAGE	##.##

Test Mode Registers

ID	Quantity	Display
901	KWH DEL	###.###
902	KWH REC	###.###
903	KVARH DEL	###.###
904	KVARH REC	###.###
905	V2H	####.##
906	KVARHQ1	###.###
907	KVARHQ2	###.###
908	KVARHQ3	###.###
909	KVARHQ4	###.###
910	INSTANTANEOUS KW DEL	###.###
911	INSTANTANEOUS KW REC	###.###
912	INSTANTANEOUS KVAR DEL	###.###
913	INSTANTANEOUS KVAR REC	###.###
914	INSTANTANEOUS KVA DEL	###.###
915	INSTANTANEOUS KVA REC	###.###
916	METER ID 1ST 6 DIGIT	
917	METER ID 2ND 6 DIGIT	
918	METER ID 3RD 6 DIGIT	
919	DEMAND INTERVAL SETTINGS	
920	OPTICAL PORT COMM SETTINGS	
921	FIRMWARE VERSION	
922	HARDWARE SETTING	
923	HEALTH STATUS	
924	NUMBER OF DEMAND RESETS	
925	TIME PRESENT	
926	DATE PRESENT	
927	INTERVAL TIME REMAINING	

Q METER DEFAULT REGISTERS

Normal Registers

ID	Quantity	Display
001	TIME PRESENT	
002	DATE PRESENT	
003	KWH DEL	####.##
004	KWH REC	####.##
005	KQH DEL	####.##
006	KQH REC	####.##
007	V2H DEL	#####.#
012	MAX KW DEL	###.###
013	TIME OF PEAK KW DEL	
014	MAX KW REC	###.###
015	TIME OF PEAK KW REC	
016	MAX KQ DEL	###.###
017	MAX KQ REC	###.###
018	MAX KVA DEL	###.###
019	MAX KVA REC	###.###
020	POWER FACTOR AT KW DEL MAX	##.##
021	POWER FACTOR AT KW REC MAX	##.##
022	AVERAGE POWER FACTOR	##.##

Alternate Registers

ID	Quantity	Display
101	TIME OF BPR	
102	DATE OF BPR	
103	KWH DEL STORAGE	####.##
104	KWH REC STORAGE	####.##
105	KQH DEL STORAGE	####.##
106	KQH REC STORAGE	####.##
107	V2H DEL STORAGE	#####.#
112	MAX KW DEL STORAGE	###.###
113	TIME OF PEAK KW DEL STORAGE	
114	MAX KW REC STORAGE	###.###
115	TIME OF PEAK KW REC STORAGE	
116	MAX KQ DEL STORAGE	###.###
117	MAX KQ REC STORAGE	###.###
118	MAX KVA DEL STORAGE	###.###
119	MAX KVA REC STORAGE	###.###
120	POWER FACTOR AT KW DEL MAX STORAGE	##.##
121	POWER FACTOR AT KW REC MAX STORAGE	##.##
122	AVERAGE POWER FACTOR STORAGE	##.##

Test Mode Registers

ID	Quantity	Display
901	KWH DEL	###.###
902	KWH REC	###.###
903	KQH DEL	###.###
904	KQH REC	###.###
905	V2H	####.##
910	INSTANTANEOUS KW DEL	###.###
911	INSTANTANEOUS KW REC	###.###
912	INSTANTANEOUS KQ DEL	###.###
913	INSTANTANEOUS KQ REC	###.###
914	INSTANTANEOUS KVA DEL	###.###
915	INSTANTANEOUS KVA REC	###.###
916	METER ID 1ST 6 DIGIT	
917	METER ID 2ND 6 DIGIT	
918	METER ID 3RD 6 DIGIT	
919	DEMAND INTERVAL SETTINGS	
920	OPTICAL PORT COMM SETTINGS	
921	FIRMWARE VERSION	
922	HARDWARE SETTING	
923	HEALTH STATUS	
924	NUMBER OF DEMAND RESETS	
925	TIME PRESENT	
926	DATE PRESENT	
927	INTERVAL TIME REMAINING	

Default DST Table

APR 04 1993, 02:00:00, Adj +60 minutes	OCT 31 1993, 02:00:00, Adj -60 minutes
APR 03 1994, 02:00:00, Adj +60 minutes	OCT 30 1994, 02:00:00, Adj -60 minutes
APR 02 1995, 02:00:00, Adj +60 minutes	OCT 29 1995, 02:00:00, Adj -60 minutes
APR 07 1996, 02:00:00, Adj +60 minutes	OCT 27 1996, 02:00:00, Adj -60 minutes
APR 06 1997, 02:00:00, Adj +60 minutes	OCT 26 1997, 02:00:00, Adj -60 minutes
APR 05 1998, 02:00:00, Adj +60 minutes	OCT 25 1998, 02:00:00, Adj -60 minutes
APR 04 1999, 02:00:00, Adj +60 minutes	OCT 31 1999, 02:00:00, Adj -60 minutes
APR 02 2000, 02:00:00, Adj +60 minutes	OCT 29 2000, 02:00:00, Adj -60 minutes
APR 01 2001, 02:00:00, Adj +60 minutes	OCT 28 2001, 02:00:00, Adj -60 minutes
APR 07 2002, 02:00:00, Adj +60 minutes	OCT 27 2002, 02:00:00, Adj -60 minutes
APR 06 2003, 02:00:00, Adj +60 minutes	OCT 26 2003, 02:00:00, Adj -60 minutes
APR 04 2004, 02:00:00, Adj +60 minutes	OCT 31 2004, 02:00:00, Adj -60 minutes
APR 03 2005, 02:00:00, Adj +60 minutes	OCT 30 2005, 02:00:00, Adj -60 minutes
APR 02 2006, 02:00:00, Adj +60 minutes	OCT 29 2006, 02:00:00, Adj -60 minutes
APR 01 2007, 02:00:00, Adj +60 minutes	OCT 28 2007, 02:00:00, Adj -60 minutes
APR 06 2008, 02:00:00, Adj +60 minutes	OCT 26 2008, 02:00:00, Adj -60 minutes
APR 05 2009, 02:00:00, Adj +60 minutes	OCT 25 2009, 02:00:00, Adj -60 minutes
APR 04 2010, 02:00:00, Adj +60 minutes	OCT 31 2010, 02:00:00, Adj -60 minutes
APR 03 2011, 02:00:00, Adj +60 minutes	OCT 30 2011, 02:00:00, Adj -60 minutes
APR 01 2012, 02:00:00, Adj +60 minutes	OCT 28 2012, 02:00:00, Adj -60 minutes

Accessories

Communication Cables & Adapters

RJ-45 to RJ-45 Cable, 7ft.	3007-132
RJ-45 to Screw Terminal Adapter	3004-047
RJ-45 to DB9F Direct to PC Adapter	4195-475
RJ-45 to DB25M Modem Adapter	4195-528
CommRepeater Adapter Box	1080-841

Analog Output Cables & Adapters

RJ-12 to RJ-12 Cable 7ft.	3007-131
RJ-12 to Screw Terminal Adapter	3004-048
RJ-12 to IDC Adapter	4195-475

Pulse I/O Cable

KYZ Pulse I/O Cable, Pigtail, 4ft.	15097-001

Electrostatic Discharge

1.1 Electrostatic Discharge Prevention

Unless controlled, electrostatic discharge can destroy or weaken solid-state electronic components and assemblies. The exact conditions that present static-damage hazards are generally unknown, as are the methods of avoiding these hazards.

Static, by definition, is designating or producing stationary electrical charges such as those resulting from friction.

An electrostatic potential is produced by friction between nonconductive materials and can best be visualized as a field between two charged plates. The electrostatic potential will exist until the difference in the potential is overcome.

The triboelectric scale shows the ability of nonconductive materials to acquire electrostatic charges. Triboelectricity is an electric charge developed on the surface of a material by friction. The materials labeled positive will take on a positive charge every time they come in contact with material lower on the scale.

Caution!

All meter shop work must be performed at static-protected work stations following properly prescribed static-control practices.

Failure Mode

Failure of a solid-state component due to static discharge is characterized by partial or complete destruction of a semiconductor junction or a microscopic resistive or capacitive element within a circuit device. Failure is most common in CMOS, very low-energy devices.

Destruction of a circuit is immediately detectable and is remedied by normal trouble-shooting and repair methods. However, the fairly common condition of partial damage induced by low-level static discharge is not immediately detectable. Thus, the damaged component may continue to operate normally, but in a weakened state. Repeated exposure of the same component to similar low levels of static discharge may produce cumulative damage ultimately leading to failure.

Static damage can be avoided by practical methods accessible to anyone handling solid-state components or assemblies.

Completely assembled products are only minimally vulnerable to static damage, and then only under the most severe of static-prone environments. Consequently, completely assembled products can be handled in normal work environments, indoors and outdoors, with no risk of static damage.

If a product is disassembled to any level, all exposed or removed electronic modules must be considered vulnerable to static damage and handled accordingly. There is no truly safe level of exposure to electrostatic discharge. However, the presence of a static charge or static field is not, in itself, damaging to electronic components.

Subassemblies from a dismantled product should not be considered static protected by design. In fact, depending on the design and conductive mass of the connected circuitry, components in subassemblies may be more vulnerable to static damage than loose components of the same type. Therefore, the objectives of static control cannot be met by indiscriminate handling of subassemblies or loose components.

Handling a printed-circuit-board assembly by its edges without employing static protection does not preclude the risk of static damage to its components. Effective static-control methods cannot be executed without proper tools and equipment.

All static-control methods relate to one simple principle: provide alternate, intentional paths for grounding electrostatic charges away from or around the devices to be protected.

Any two physical bodies, conductive or nonconductive, can be the source of an electrostatic discharge if each is charged to a different level of electrostatic potential. As these two physical bodies come in contact or proximity, equilibrium is achieved by a sudden flow of current.

Most people associate a static discharge with a small blue arc and a sharp snapping noise. It is important to note that static charges of a level too low to produce a detectable arc can damage unprotected electronic components.

Static control is the employment of tools and equipment to predetermine the flow path of this current.

Another important consideration is that even though a safe encounter has been achieved between two physical bodies, any subsequent encounter with a third, fourth, or more bodies must be protected in the same manner since a static potential difference may exist between the, now combined, first two bodies and any unknown new body.

Warning!

The first step in the above example is to de-energize the meter in such a manner as to completely isolate the meter from all service lines. Never dismantle an energized meter.

The following static-control equipment is required:

1. Conductive work mat
2. Ground cord attached to true earth ground
3. Conductive wrist strap
4. Electrically conductive bag

Caution!

Unless you are certain that the meter enclosure is properly earth bonded, do not attach the ground cord to the meter enclosure. Never attach a ground cord to the distribution system neutral or any other point inside the meter enclosure, as this can present a serious safety hazard.

Attach the conductive work mat and the conductive wrist strap to the ground cord. Put on the wrist strap and remove the assembly from the meter. If work is to be performed on the assembly at the metering site, perform it on the grounded work mat.

If the assembly is to be transported to the meter shop or other off-site location, insert the assembly into a conductive, antistatic bag for safe transportation. If the assembly has a battery installed, remove the battery before inserting into the bag for transportation. Conductive, antistatic bags can cause a battery to discharge during the transportation process.

If sensitive components are removed from the assembly at the meter site and are to be reused, insert the components—with all component leads piercing into a piece of conductive foam carrier—into an antistatic bag for safe transportation.

Static kits including mat, wrist strap, cord, and clip are available through Scientific Columbus. To order, contact Scientific Columbus' Sales Department at 800/274-5368 or 614/718-3870. Ask for item #13443-001.

Serial Commands and Responses

CMD	EXT	Description	Hardware Key Required	Password Required
05	none	Query Status		none
06	01	Query JEM10 Status		none
06	02	Read Phone-Home Status		none
42	01	Demand Reset		HI
43	01	Configure DST Information	Y	HI
43	02	Configure TOU Special Dates	Y	HI
43	04	Configure Register Definition	Y	HI
43	06	Configure Register Display Info.	Y	HI
43	08	Configure Load-Profile Info.	Y	HI
43	09	Configure Phone-Home Modem	Y	HI
43	0a	Configure Comm. Parameters	Y	HI
43	0b	Configure Demand Interval	Y	HI
43	0c	Configure Miscellaneous Info.	Y	HI
43	0d	Control Configuration Session	Y	HI
43	0e	Configure Modem Information	Y	HI
43	10	Configure Pulse Dividers	Y	HI
43	11	Configure Configuration ID	Y	HI
43	12	Configure TOU Rate Schedule	Y	HI
43	13	Configure TOU Enable	Y	HI
43	14	Configure Misc. Demand Info.	Y	HI
43	15	Configure Mode Timeouts	Y	HI
43	16	Configure Register Algorithms	Y	HI

CMD	EXT	Description	Hardware Key Required	Password Required
44	01	Read Load-Profile Info. (JEM10 specific)		LO
44	02	Read Load-Profile Info. (JEM2 specific)		LO
44	03	Read Configuration Events		LO
44	04	Read Register Preset Events		LO
44	05	Read Init. Events		LO
44	06	Read Event Buffer		LO
4c	01	Freeze		none
4d	01	Enter Test Mode	Y	HI
4d	02	Exit Test Mode		none
4d	03	Step Test Mode Display		none
50	01	Password Activate		none
50	02	Password Deactivate		none
50	03	Password Change	Y	HI
52	01	Binary Read Register (JEM2 specific)		none
52	02	Read Normal Registers		none
52	03	Read Alternate Registers		none
52	04	Read Test Registers		none
52	05	Read All JEM10 Registers		none
52	06	Read Normal Registers, Descriptive		none
52	07	Read Alternate Registers, Descriptive		none
52	08	Read Test Registers, Descriptive		none
52	09	Read All Registers, Descriptive		none
53	01	Health Check (JEM2 specific)		LO
53	02	Health Check (JEM10 specific)		LO
54	01	Time Set (JEM2 specific)		HI
54	02	Time Verify--Current Time		none
54	03	Time Verify--Time of Last Freeze		none
54	04	Time Verify--Time of Last Demand Reset		none
54	05	Time Set (JEM10 specific)		HI
56	01	Verify Config.--DST Information		LO
56	02	Verify Config.--TOU Special Dates		LO
56	04	Verify Config.--Register Definition		LO
56	06	Verify Config.--Reg. Display Info.		LO
56	08	Verify Config.--Load-Profile Info.		LO
56	09	Verify Config.--Phone-Home Modem		LO
56	0a	Verify Config.--Comm. Parameters		LO
56	0b	Verify Config.--Demand Interval		LO
56	0c	Verify Config.--Misc. Info.		LO
56	0e	Verify Config.--Modem Info.		LO

CMD	EXT	Description	Hardware Key Required	Password Required
56	10	Verify Config.--Pulse Dividers		LO
56	11	Verify Config.--Configuration ID		LO
56	12	Verify Config.--TOU Rate Schedule		LO
56	13	Verify Config.--TOU Enable		LO
56	14	Verify Config.--Misc. Demand Info.		LO
56	15	Verify Config.--Mode Timeouts		LO
56	16	Verify Config.--Register Algorithms		LO
57	01	Preset Registers	Y	HI
63	01	Config. Independent Item--Date Format	Y	HI
63	02	Config. Independent Item--DST Adjust	Y	HI
63	03	Config. Independent Item--LP Size	Y	HI
63	04	Config. Independent Item--Meter ID	Y	HI
63	05	Config. Independent Item--Scroll Rate	Y	HI
63	06	Config. Independent Item--User Text	Y	HI
6d	01	Erase Mass Memory	Y	HI
70	01	Schedule Next Phone Home		HI
70	02	Retrieve Power Fail Event Parameters		none
70	03	Set Modem Configuration Profile	Y	HI
71	01	Read Next Scheduled Phone Home		LO
71	03	Read Modem Configuration Profile		LO
76	01	Verify Independent Item--Date Format		LO
76	02	Verify Independent Item--DST Adjust		LO
76	03	Verify Independent Item--LP Size		LO
76	04	Verify Independent Item--Meter ID		none
76	05	Verify Independent Item-Scroll Rate		LO
76	06	Verify Independent Item--User Text		none
none	none	"I" Command		none

Glossary

Apparent Power
The product of the applied voltage and current in an ac circuit. Apparent power, or volt-amperes, is not the real power of the circuit because the power factor is not considered in the calculation.

Average Power Factor
The ratio of kilowatthour pulses to computed equivalent kVAh pulses for the billing period.

Billing Period
The period of time between two consecutive demand resets.

Burden
Load imposed by a device on an input circuit, expressed in ohms or VA.

Calibration Accuracy
The requirement for percent-of-reading registration accuracy at a specified set of conditions or range of conditions. For the JEM10 meter, the calibration accuracy is the maximum absolute error allowable for conditions of nominal voltage, power factor, frequency, and temperature over a range of current (load) between 10 percent and 100 percent of full scale (class current).

Class, Class Amps
The maximum current for which a meter is specified to operate within its accuracy rating. Nominal voltage and unity power factor are assumed.

Daily Schedule
The daily schedule is an array of times and rates, and it determines the moment at which a TOU period changes.

Demand Deferral
A period immediately following a power outage during which demands are not calculated. It is determined by the number of demand-interval closures following the power outage.

Demand Reset
A scheduled or user-initiated event that causes maximum demands to be zeroed and certain other calculations to occur.

Full Scale
A reference condition corresponding to the highest rated value of a given measurement. For watts, this condition occurs at nominal-rated voltage, class current rating, and unity power factor. For vars, full scale is at nominal voltage, class current, and zero power factor.

Holiday
For TOU purposes, a holiday is a date contained in the holiday schedule.

Holiday Schedule
A holiday schedule is an array of dates (in seconds time format at midnight) within the TOU schedule that enables the meter to identify holidays.

Interval
A period over which a demand is calculated consisting of one or more subintervals.

IRLED
Infrared light-emitting diode, such as the optical port on the JEM10 meter.

Liquid Crystal Display (LCD)
Display area on the meter face that contains alpha-numeric characters for data readout.

Load Linearity
Specifies the maximum deviation of performance in percent registration over a range of current (load) assuming all other conditions at nominal reference conditions.

Load Profile
Load profile is the collection of all LP records in chronological order.

(Load Profile) Periodic Special Event
The meter stores pulses accumulated since the time of the previous LP interval closure.

Load Profile Interval
An LP interval is the period between two consecutive LP interval closures.

Load Profile Record
An LP record is the data in a segment of load-profile memory where the accumulated pulses from a single LP interval are stored.

Null Modem
Cable that emulates a modem to enable the connection of two DTE (data terminal equipment) devices such as any two devices that would communicate with a modem (DCE) device.

Partial Load Profile Count
The total accumulated counts within an interval after the last special event or load-profile interval closure.

Power Factor
The ratio of the effective power to the apparent power. Equal to the cosine of the phase angle.

Present TOU Period
The one TOU period that the meter determines to be active at the present time. This is determined by the present date and time of the meter and the TOU schedule.

Pulse
A state change in either direction of a binary metering signal.

Register
Used to refer to specific quantities to be displayed or retrieved.

Register Assembly
The term used to refer to the hardware implementation of the display or control of the I/O functions of the meter.

Rolling Interval/Sliding Window
A demand measurement consisting of the summation of values calculated over multiple consecutive subintervals. A calculation is updated at the completion of each subinterval, but includes a defined number of previous subintervals.

Season
A season is a range of dates whose start date is contained in the season schedule in seconds time format.

Season Schedule
A season schedule is an array of dates within the TOU schedule that enables the meter to identify the seasons.

Seconds Time Format
A 32-bit number in units of seconds referenced from January 1, 1990.

Special Event
An event stored in load-profile data such as a register freeze, power fail, time set, etc.

Storage Register
A copy of a quantity which could be a displayable register and is saved when triggered by a demand reset.

Subinterval
The increment of time in which demand calculations are updated.

Time
Time indicates hours, minutes, and seconds of a minute.

Total Registers
Those JEM10 registers that are not TOU registers are called total registers. The total registers always are active.

TOU Period
A selected duration of time during which the consumption, demand, and other information are assigned to a set of TOU registers.

TOU Rate Indicator Output
A display segment that indicates the present TOU rate in effect.

TOU Register
A TOU register is a register of the JEM10 meter that, for a designated TOU period, accumulates and may display amounts of electrical energy, demand, or other quantities measured or calculated.

TOU Schedule
The TOU schedule is a static, externally configured database within the meter. The data base contains information that allows the meter to determine the present TOU period based upon the real date and time of the meter.